Proceedings of the

Missouri Catfish Conference

March 10-11, 1970
Lake Ozark, Mo.

MP 296, 1972 Extension Division, University of Missouri-Columbia

FOREWORD AND ACKNOWLEDGMENTS

Representatives of the cooperating agencies jointly decided that a catfish conference would be one way to disseminate information concerning this rapidly expanding industry. Leading fishery scientists, industry representatives and other agency personnel were invited to participate. The conference was designed to provide information to those people interested in the true commercial aspects of this agri-business enterprise.

The conference was truly a cooperative effort; all agencies contributed in some way. Jack Slusher, University of Missouri; Jim Kahrs, Missouri Fish Farmers Association; and Glenn Peterson, Missouri Department of Agriculture, did much of the footwork. Administratively, we received the assistance of Charles A. Purkett, Jr., Chief, Fisheries Division, Missouri Department of Conservation; Dr. Schell Bodenhamer, Associate Dean for Extension, University of Missouri; Lowell Mohler, Director, Marketing Division, Missouri Department of Agriculture; and Stanton Hudson, President, Missouri Fish Farmers Association. For this support we are all grateful.

A special thanks is due to all of the speakers who so graciously gave of their time and talent. Their excellent presentations were the backbone of the conference's success. Also a special thanks to the many people of the various agencies who helped provide names for mailing lists, made advance preparations and took care of the myriad details necessary for a smooth meeting.

The editor took tremendous liberties in adapting the presentations for this publication and in doing so accepts full responsibility for errors and inconsistencies.

Joe G. Dillard
March 1972

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MISSOURI CATFISH CONFERENCE

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Federal Assistance

Max Hamilton (Deceased)

My assigned subject is federal assistance to fish farmers. However, I have taken the liberty of limiting the discussion to help available from two agencies of the U.S. Department of Agriculture: the Soil Conservation Service and the Farmers Home Administration.

The Soil Conservation Service's primary responsibility is assisting Soil and Water Conservation District Cooperators in the conservation and development of land and water. Since fish production is based on the use of these resources, the Service will give help to farmers and other landowners who are interested in developing fish farms. This help is the same as for any other rural enterprise. It consists of planning assistance in which the farmer is given preliminary information about possible land uses and the suitability of the land to support them. Then following his decision on the land use he desires, technical assistance is given on layout and construction.

When a prospective catfish farmer comes to us, we try to impress on him the fact that fish farming is still somewhat in the developmental stage, that it is a complicated business demanding considerable knowledge and experience, and that it requires a large financial investment.

We give the farmer general information about the factors involved in fish farming and tell him where he can get additional detailed literature. We also encourage him to see knowledgeable persons in other agencies and to visit established fish farms. If he desires, we inspect the site and advise him on the possibilities for reservoir construction and water supply.

We are not trying to sell the business of fish farming. We realize that Missouri is a "border state" in its potential for successful catfish farming because of short growing seasons, particularly in the north half of the state, and because in many areas water supplies are inadequate or expensive. However, if after considering available information the landowner selects this as a land use, we will help him establish a facility designed as well as it can be within the limitations of the site.

Help from the SCS can include technical assistance for site selection, engineering design, location and development of water supply, layout and supervision of construction, and vegetation of levees and other critical areas.

The Service will attempt to give engineering help to coincide with the landowner's schedule of activities as nearly as possible, but it should be pointed out that our engineers have a heavy work load and previously scheduled requests may cause some delay. For this reason, we recommend that planning be made as far in advance as possible.

SCS does not staff specialists in fish culture. For this reason, District Conservationists will not give on-site management assistance to fish farmers, nor will they attempt to supervise or guide them in carrying out cultural activities. They will, however, make every attempt to guide the cooperator to sources of available help.

Credit assistance is available to catfish farmers through the Farmers Home Administration.

FHA makes both farm ownership loans and operating loans. Applications are made to the FHA county supervisor. To be eligible for any FHA loan, the applicant must:

1. Have a farm background or the farm experience necessary to be successful in the proposed farming operation.
2. Possess the character, industry, and ability to carry out the proposed farming operation.
3. Manage and operate the farm.
4. Be unable to obtain sufficient credit elsewhere at reasonable rates and terms.
5. Be a citizen of the United States and of legal age.
6. After the loan is made, be an owner or tenant operating not larger than a family farm.

Farm ownership loans may be used to buy or enlarge farms, to construct, improve, or repair farm homes and service buildings, to drill wells and otherwise improve water supply systems for home use, livestock, and irrigation, and to re-finance debts. In addition, among other uses, these loans may be used to provide facilities to produce fish under controlled conditions and to finance recreational enterprises such as pay-fishing lakes.

The interest rate is five percent per year on the unpaid principal and the maximum term for repayment is 40 years.

Operating loans may be used for almost any type of farm operating expense. Specifically included as eligible expenses are those connected with the production of fish under controlled conditions and to finance recreational enterprises including fee fishing.

The present interest rate is 6-5/8 percent per year on the unpaid principal. Each loan is scheduled for repayment within a period consistent with the borrower's annual ability to repay although the maximum term is usually seven years.

Interested persons should visit the FHA county supervisor in their home county for more information.

Fingerlings to Food Fish

O. L. Green

Channel catfish fingerlings may be reared in ponds or troughs. In the pond environment, a low cost pelleted fish or livestock feed may be used, but in the trough environment a more expensive, balanced feed for fish is used. In both environments, different methods and techniques are often employed to stock, feed and harvest the fish. The choice of methods depends on the facilities and labor available, and number and size of fingerlings to be produced.

Regardless of the rearing method selected, some attention should be given to the water supply. In the trough rearing-method of culture, the incoming water should range between 70 and 85° F. and contain no less than 6 ppm dissolved oxygen. Other factors such as pH, hardness, dissolved iron content and many others associated with using well water will influence production of fish in troughs. When using water from ponds for trough culture, the latter factors for the most part can be disregarded. In the pond rearing-method of culture, the major factor to be considered is the presence of fry-eating insects and fish. The predator fish can be controlled by filling the pond with fish free water (well) or by using a fine mesh screen to filter water from other sources. The fish-eating insects can also be controlled by applying No. 2 diesel fuel or kerosene at the rate of 5 gallons per surface acre prior to stocking the fish and every 10 days thereafter until the fish reach 1½ inches in length.

In the trough culture of fingerling catfish, either sac fry from the hatching trough or from spawning containers in the ponds may be used. This is a good cultural practice if time and facilities permit, since it gives the fish-culturist greater control of the small fish. Also, if these fish (approximately 3/4-inch in length) are stocked in the rearing ponds, approximately 60 to 90 percent can usually be harvested. This gives the fish-culturist a fair estimate of the number of fish in each pond.

Troughs may be constructed of wood or metal. Most fish-culturists prefer a trough 8 to 12 feet in length, 12 to 15 inches wide and 8 to 10 inches deep. Water enters at the head of the trough at the rate of 1 to 5 gallons per minute, depending on the weight of fish, and exits through a standpipe drain at the rear of the trough. A screen is usually installed at the rear of the trough to prevent the escape of the fish.

Feeding is extremely important, particularly for the first week or so when they are just learning to feed. For 6 - 8 days after hatching, the fry subsist on their yolk sac and will remain on the bottom of the pond or trough. After absorbing the yolk sac they become "swim-up" fry. If the fish are confined in a trough they will be seen swimming the sides and surface of the trough in search of food. Those fish which do not learn to feed during the first few days after absorption of the yolk sac will die.

In pond culture of catfish fingerlings, either non-feeding sac fry or feeding fingerling fish may be stocked. Feeding fingerling fish can be obtained from rearing troughs described above or by carefully observing the yolk-sac fry in the spawning containers and removing the fry from the containers when they start to feed.

When stocking the sac fry or trough-started fingerlings, some fish-culturists place the tub, which was used to transport the fry, inside a small enclosure of fine mesh screen wire within the pond. Thus, the fish are confined to a small area until they are feeding well, at which time both the tub and retaining screen may be removed.

Stocking rates vary depending on the length of the culture period and the size of fingerling desired. In general, when the fish are to be harvested at the 2 to 4-inch size at the end of approximately 120 days, they can be stocked at the rate of 100,000 to 150,000 per acre. However, if a 6 to 8-inch size fish is desired, the stocking rate should be reduced to 14,000 to 20,000 per acre. A combination of these methods can often be employed whereby the fish can be stocked at the maximum rate initially and then partially harvested for sale or restocking when they reach the 2 to 4-inch size.

In order to estimate the number of fish to be stocked, several methods may be used. Female channel catfish generally produce about 2,000 eggs per pound of body weight. By knowing the weight of the broodstock, the fish-culturist may estimate the number of fry produced when the eggs hatch. Another method is estimation by weight or volume. Channel catfish sac fry (less than 7 days after hatching) number approximately 1,000 per ounce when measured volumetrically or weighed. A graduated plastic cylinder obtainable at any photographic supply store is suitable for volumetric measurements. When stocking fish 1/4 to 1-inch in length, sample weight and number counts may be taken and the number to weight ratio calculated. The number of fish stocked can then be estimated by weight, eliminating the time consuming chore of counting.

To completely harvest the fingerling catfish, the pond should be drained. However, up to 75 percent of the fish may be removed prior to draining the pond by seining around the feeding areas. Harvest can best be accomplished in the early morning hours while the water and air is cool. Care should also be taken to avoid excessive muddying of the water. It is important to consider possible seining sites (firm bottom free of obstacles) when establishing feeding areas.

A healthy fingerling, good environment and a conscientious feeding program are obvious criteria for a profitable food-fish production program. The fingerling, whether you raise your own or purchase them from a dealer, should be a minimum of two inches in length when stocked in a grow-out pond. First, a larger fish is less apt to fall prey to his natural enemies, and secondly, if the fish die from disease, adverse water conditions or mishandling prior to stocking, they will be large enough to be noticed.

The importance of good environment includes control of predators. Snakes, bullfrogs, and fish-eating birds are the three most common enemies of fingerling catfish. Snakes can best be controlled by keeping the grassed banks and surrounding areas closely mowed, and by picking up boards, pipes and debris on the pond banks. By removing their hiding places and killing the ones you see, snakes can be controlled reasonably well.

These techniques also apply to adult bullfrogs. Frog eggs may be removed from the ponds mechanically or poisoned by placing a few crystals of copper sulfate on the egg masses. Tadpoles, considered competitors of catfish by occupying space and eating fish foods, may be controlled by one of several products on the market. Most water birds are protected by federal and state law. Of these, kingfishers, little green herons, grebes, mergansers, and great blue herons are probably the worst feathered predators of fingerling catfish in our area and can be a serious problem if present in large numbers. The use of fireworks and other noise and light producing devices to keep these predators out of ponds are of limited value.

The common "snapper" is the only pond dwelling turtle that is of any importance as a fish predator and is not generally present in significant numbers to be a problem. The most common pond turtle is the "slider". Although the slider turtle is not a fish eater, it competes with the catfish by consuming the commercial fish feeds and natural foods. The slider is also objectionable at harvest time as some of them bite. Slider turtles can be effectively controlled by trapping and afford good sport when plinked with a .22 rifle.

Time of stocking can be an important factor but is not as critical as some people believe. A pond should be stocked when it is ready to receive fish, whether in July, August, November or March. A two-inch fish stocked in a grow-out pond in July will be a robust 9 - 10-inch fish by November in our latitude (central Alabama) and can be fed intermittently all winter long.

The poorest stocking months, in my opinion, are December and January. The fish are feeding less at this time of year and are more difficult to re-start on feed after being moved to the grow-out pond. Also, the fish that die after stocking at this time of year may never be observed.

Catfish production is an industry well adaptable to the South because of the long growing season and warm winters. However, many fish growers reduce this advantage by not feeding during the winter months. Don't feed when the water temperature is below 60° Farenheit is taken literally by many fish farmers. Actually, catfish will consume pelleted feeds at water temperatures below 40°. However, the fish are slow moving and will not seek out feed as they do when the water is warmer. Also, they consume less feed at each feeding and metabolize the food much more slowly in cooler water. Therefore, feeding rates and frequency should be reduced according to climatic conditions but not discontinued altogether.

Starting the fingerlings on feed soon after stocking in a grow-out pond is of primary importance. A healthy, well-fed fish will not only be more resistant to parasites, disease and predators, but will reach a marketable size sooner. Quick training of the fish to feed can be accomplished by stocking the pond before it is full and by feeding around the entire water edge. An acre of water in a 10-acre pond is usually sufficient for stocking 20,000 fish provided the pond will completely fill within a reasonable time.

Once started on food, a good feeding program should be initiated and followed. Food rations are usually based on 3 percent of the estimated weight of fish in the pond with lesser rates during the unusually hot and cold periods. Feed is usually offered in the early morning or late afternoon during the warm months and only during the late afternoon during the cool months. If a sinking pellet is used, it is desirable to scatter the feed along the shallow bottom areas so that the feeding activity of the fish can be observed. Feeding activity is a good index of the well-being of the fish: rapid and vigorous consumption of the food is suggestive of good environmental conditions and good health whereas, slow or no feeding is suggestive of poor environmental conditions (low oxygen) or disease. Floating feeds can be offered over all areas of the pond but as with the sinking feeds it is best to scatter the pellets over a wide area.

A fish's environment is water, and the quality of this water determines the degree of well-being of the fish. Catfish are raised in waters from every conceivable source with varying degrees of success. The best quality water, in most instances, comes from wells. However, water from clean streams or springs is usually suitable if it is not contaminated with pesticides from farming operations.

It is not economically feasible to feed a pond of catfish when wild fish are present. If the water source contains wild fish, then it should be filtered through fine mesh screen or woven saran. In some instances, stocking 50 fingerling bass per acre will effectively control wild fish and there is a selective fish toxicant (Antimycin) on the market which will kill Centrachids (sunfish) without harming catfish.

Oxygen depletion of the water is one of the biggest problems incurred when raising catfish to food-fish size. Most oxygen depletion kills are preceded by a dieoff of phytoplankton aggravated by the decay of uneaten feeds and fecal waste. Usually when excessively thick phytoplankton blooms occur, it is desirable to add fresh water to the pond. The amount of food offered should be reduced or discontinued until the condition is improved.

The pond environment is also influenced by aquatic vegetation. Although rooted aquatics and filamentous algae are not as troublesome in catfish grow-out ponds as in some other forms of fish culture, they should be eradicated if they do appear. Mechanical (raking or pulling) and chemical control are the only two that appear feasible in a grow-out or food-fish situation.

When controlling vegetation chemically there are several factors to remember. There are only a few chemicals that have USDA clearance for use in fish ponds and the labels on some of these are quite restrictive. When treating a pond with chemicals one should be aware of the concentration that may be lethal to the fish, and that killing too much vegetation at one time can result in an oxygen depletion. Complete fish mortality may occur when the vegetation decays.

Similar cultural techniques apply to the channel, blue and white catfish. Our experience at the Southeastern Fish Culture Laboratory indicates that the blue catfish grows more uniformly, learns to feed at the pond surface more readily and dresses out better than either the channel or white catfish. The blue catfish is also more difficult to culture and to transport than either the channel or white.

The white catfish is more tolerant of crowding, high water temperatures and low oxygen than the channel or blue but does not dress-out as well. Some fish-out operators like the white catfish because it bites well in extremely hot weather.

Each of these three species has somewhat different feeding habits and it is probable that an increase in production can be accomplished by a combination stocking. The beginning farmer should probably culture the channel catfish, but the possibilities of the blue and the white should not be overlooked.

Food and Nutrition of Channel Catfish

Otto W. Tiemeier

Investigations on feeding dry pelleted feeds to channel catfish were initiated at Kansas State University in 1958. Fish were fed in farm ponds and in small earthen rearing ponds.

In 1964, the Tuttle Creek Fisheries Research Laboratory was established. Facilities include 28 plastic-lined ponds, 1/7-acre surface area each, and a laboratory building. Analytical and milling equipment are also available on the university campus. Each pond has inlet and outlet valves to control the water level. The plastic liners provide similar environmental condition in all ponds. Funds have been obtained from the Kansas Agricultural Experiment Station, Kansas Forestry, Fish and Game Commission, Bureau of Commercial Fisheries, Bureau of Sport Fisheries and Wildlife and from industry.

The primary objective in a feeding program is to provide a food that will promote good growth of fish at the least cost. Proteins in feed for fish are used primarily as building blocks in the formation of animal tissues and secondarily as sources of energy. Fats or oils and starches are used as materials to provide energy for body processes. High levels of proteins in diets for animals constitute a large percentage of feed costs. Fats and starches should be sufficient to provide the energy and thus reserve the proteins to be used for growth.

In 1964, little information was available on the levels of protein or energy required for growth of channel catfish; the amount of feed to give daily; how or when to feed the fish; water temperatures required to promote good growth; rate of digestion; digestive enzymes present; requirements for winter feeding and many other basic questions related to the nutrition of channel catfish.

Our experiments in 1964 were designed to compare feeds containing 25 or 35% protein and two levels of energy for each level of protein (Table 1). Generally, fish were given pelleted feed (3/16-inch in diameter) six days per week. Feed was spread in a line along the shallow edge of the pond approximately the same time each day. Samples of fish were taken biweekly and the amount of feed given daily increased after each weighing period. Fish were counted and weighed when stocked and also when removed.

Table 1. Data and results on 4 diets used in 1964. 4 ponds, 4% feeding rate, 2000 fingerlings, initial weight 8 grams.

Items	Diets Z-5	Z-6	Z-7	Z-8
Percentage protein	25	25	35	35
Kcals/lb. feed	750	850	1050	1190
Lbs. fish/pond	183	319	304	304
Protein/lb. gain	410 (g)	239	342	332
Lbs. feed/lb. gain	3.49	2.00	2.10	2.10
Mean percentage survival	98.5	96.1	98.0	96.8

Upon termination the data indicated growth and rate of feed conversion were not good with diet Z-5 containing 25% protein and 750 kilocalories per pound. Results with the other diets were similar. Diets containing 35% protein did not improve growth.

Experiments in 1965 were designed to compare diets containing: (1) 25% protein and 850 Kcals; (2) 25 % protein and 950 Kcals; (3) 25% protein and 850 Kcals but low animal and high plant proteins; and (4) 30% protein and 1020 Kcals per pound.

Data (Table 2) indicated growth was not improved by increasing Kcals to 950 per pound of feed at the 25% protein level (Z-15) or by increasing protein level to 30% and energy to 1020 Kcals in diet Z-17. Growth obtained with the low animal but high plant protein diet (Z-16) were similar to the high animal and low plant protein diet (Z-14).

Table 2. Data and results on 4 diets used in 1965. 3 ponds, 4% feeding rate, 950 fish, initial weight 2.32 grams.

Items	Diets Z-14	Z-15	Z-16(1)	Z-17
Percentage protein	25	25	25	30
Kcals/lb. feed	850	950	850	1020
Lbs. fish/pond	170	161	161	167
Protein/lb. gain	118 (g)	124	124	144
Lbs. feed/lb. gain	1.04	1.09	1.09	1.05
Percentage survival	95.7	96.1	94.2	95.2

(1) Low animal protein (50 lbs. fish meal, 50 lbs. meat and bone scraps per ton of feed.)

Our conclusions after 1965 were: (1) levels of energy above 850 Kcals per pound did not improve growth of fingerlings and (2) diets containing 25% protein were adequate when levels of the various amino acids were properly balanced.

Some channel catfish were processed and determinations made of the levels of amino acids in the muscles of these fish. Diets in 1966 were devised to: (1) be similar in certain amino acid levels as in the fish; (2) compare results obtained by feeding diets containing 22 or 25% protein; (3) compare results by feeding diets containing additional B vitamins (Table 3); and (4) compare growth obtained by feeding once or twice daily.

Table 3. Data and results on 6 diets used in 1966. 2 ponds/treatment, 4 and 3% feeding rate, 600 fingerlings, 14.7 grams initial weight. 1966.

Items	Diets Z-14	Z-19	Z-20	Z-21	Z-22	Z-25
Percentage protein	25	25	22	22	25	25
Kcals/lb. feed	850	850	858	858	850	850
Added B vitamins	+	-	+	-	+	-
Balanced amino acids	-	-	+	+	+	+
Lbs. fish/pond	162	145	141	135	143	148
Lbs. feed/lb. gain	1.62	1.8	1.85	1.94	1.82	1.77
Percentage survival	91.0	95.9	93.1	96.8	98.6	94.2

In comparing the results (Table 4), we noted growth with diets containing balanced amino acid levels were slightly better than with the non-balanced diets and addition of B vitamins may have improved growth but the differences in both instances were not significant. Growth obtained with 22% protein diets was slightly better than the 25% protein diets but the differences were not significant. Some improvement was noted (Table 5) when fish were fed twice daily compared with once daily feedings but the differences were not significant and should be compared with the cost of additional time required to feed more than once daily.

Table 4. Comparing various regimens used in 1966 feeding program.

	Percentage survival	Grams gain per fish	Lbs. gain per pond	Feed conversion
Balanced amino acids(1)	93.5	126	153	1.7(2)
Non-balanced amino acids(1)	96.3	113	145	1.8
Added B vitamins(1)	94.8	123	152	1.72
B vitamins not added(1)	95.0	117	146	1.79

(1) Mean data from 4 ponds.

(2) Differences not significant.

Table 5. Comparisons of diets containing 25% versus 22% protein and one versus two daily feedings. 1966.

	Percentage survival	Grams gain per fish	Lbs. gain per pond	Feed conversion
25% protein, 8 ponds	94.9	120 (1)	149	1.75 (1)
22% protein, 4 ponds	94.9	111	138	1.89
25% protein, 2 ponds (2)	94.5	123	153	1.71

(1) Differences not significant.

(2) Fed in AM and PM.

By an error, 200 fingerlings were stocked into one pond instead of the intended 600 during 1966. This error was first noted when fish were removed in the fall. Comparisons of results are presented in Table 6. The 200 fish gained much more weight individually than those stocked at 600 per pond, but total production and rate of feed conversion were similar for the two ponds. For good growth of fingerlings to the marketable size of 14 to 18 ounces, we recommend stocking 1500 fingerlings per acre and not more than 2000 per acre of water.

Table 6. Comparisons of the same diet fed at 3 and 2.5% to fish stocked at 200 and 600 per pond. 1966.

Stocking rate	Percentage survival	Grams gain per fish	Lbs. gain per pond	Feed conversion
200	100	241	106	1.85
600	94.5	90	111	1.76

The 1967 experiments with fingerlings were designed to compare growth obtained with diets containing 25% versus 18% protein and a 3% versus 2.5% daily rate of feeding. Results (Table 7) indicated growth and rate of feed conversion were better when fish were fed the 25% protein diets and growth was considerably better with the 3% daily feeding rate. However, rate of feed conversion was better with the 2.5% daily feeding rate, but fish did not grow as much.

We compared growth and rate of feed conversion obtained with four diets in 1968 as follows: Z-14 (sinking); Z-14 (floating); Z-34 containing only 5.2 pounds of fish meal and 14.8 pounds of meat scraps per ton of feed as sources of animal proteins; and Z-35 containing a high percentage of brewers dried grains. Results (Table 8) indicated fish did not grow well when fed the brewers dried grains. They did better when fed the low animal protein diet and also grew slightly better when fed the sinking versus the floating pellets. However, when we analyzed the floating pellets, we noted that sufficient additional starches had been added to the floating diet formula to decrease the protein level by one percent. This may have caused the slightly lower growth.

Floating pellets have several advantages to sinking pellets for the fish grower. He can observe the activity of the fish and obtain some idea of their well-being. Also he can feed the amount they will take in a given time. Feed need not be wasted to foul the water and contribute to an oxygen problem.

In order to compare growth of different size fish, a population of age group II fish were separated into large and small fish. Equal weights (Table 9) of large fish and small fish were stocked into two ponds, equal numbers of large fish (179) into two ponds and an equal number of small fish (179) into two ponds. Fish were given the same feed and fed at the same rate on the basis of average weight of fish in each pond.

Results (Table 10) indicated the fewer large fish gained as much total weight as the more numerous small fish because individual large fish gained more weight. For each one gram difference in initial weight, there was approximately three grams difference in final weight between the two groups.

To further compare growth of small and large fish, 200 fingerlings were stocked with 50 age group III fish. The older fish weighed six ounces more than the fingerlings. By error, 600 fingerlings were stocked into Pond No. 17 with the 50 age group III fish.

Results (Table 11) indicated growth of the large fish in Pond No. 17 was similar to that obtained in the other ponds, but gain per fish for the small fish was only 107 grams compared with an average of 196 grams in the other ponds. In other experiments during the same year, an average gain of 121 grams per fish was obtained in 10 ponds

Table 7. Comparisons of 25% versus 18% protein diets and 3% versus 2.5% daily feeding rates. 1967.

	Percentage survival	Grams gain per fish	Lbs. gain per pond	Feed conversion
25% protein, 10 ponds	91.5	110	110	1.49
18% protein, 10 ponds	94.5	94	97	1.69
3% feeding rate, 12 ponds	91.4	109	108	1.64
2.5% feeding rate, 8 ponds	95.5	92	96	1.52

Table 8. Data and results on 4 diets used in 1968. 3 ponds, 3% feeding rate, 500 fingerlings, initial weight 9.65 grams.

Items	Z-14 Sinking	Z-14 Floating	Z-34(1) Low an. prot.	Z-35 Brewers
Percentage protein	25	25	25	25
Kcals/lb. feed	850	850	850+	850
Lbs. gain/pond	109	100	104	74
Lbs. feed/lb. gain	1.13	1.23	1.18	1.65
Percentage survival	99.8	99.2	99.6	98.7
Feed cost/lb. gain (cents)	5.76	6.58	5.68	5.46

(1) Contained 5.2 lbs. of fish meal and 14.8 lbs. of meat scraps per ton.

Table 9. Stocking small and large age group II fish, 1965.

Pond No.	No. of fish	Total wt. g.	% survival	Gain/ fish	Feed conversion
2	35 lge	3405	100	540	
2	67 sm	3405	97	382	
Total		6810			2.07
6	31 lge	3405	100	544	
6	66 sm	3405	100	415	
Total		6810			2.04
3	179 lge	16456	86	455	
10	179 lge	13620	99.4	374	
Total		30076			2.66
8	179 sm	10980	100	321	
12	179 sm	10896	100	336	
Total		21876			2.30

Table 10. Comparisons of large and small age group II fish, 1965.

	Stocking weight grams	Recovery weight grams	Total gain lbs.	% gain
Small (491)	56.3	364	374	652
Large (424)	93.6	478	374	461
Difference	37.3	114		

Table 11. Stocking 200 (16.3g) age group I with 50 (183.4g) age group III fish, 1966. Feeding rate 4 and 3%.

Pond No.	Total stocking wt.	Mean wt. gain	Total gain, lbs.	Feed. conv. lge + small
		Age group I		
3	3256	203	84	2.37
17(1)	9768	107	132	1.77
4	3256	199	83	2.41
18	3256	185	79	2.30
Mean 3,4,18		195	82	2.36
		Age group III		
3	9478	545	34	
17	9095	479	28	
4	9392	437	33	
18	8711	511	43	
Mean		493	34	

(1) 600 small fish stocked instead of 200.

each stocked with 600 fingerlings and the mean weight gain in a pond stocked with only 200 fingerlings was 241 grams. Growth became progressively less in the following stocking regimens: (1) 200 fingerlings; (2) 200 fingerlings plus 50 age group III fish; (3) 600 fingerlings only and (4) 600 fingerlings with 50 age group III.

To compare 3 feeding methods, nine ponds were stocked with 240 fish 8 to 10-inches long in the spring of 1969. Fish in three ponds were fed daily, six days per week by spreading the feed along the edges of the ponds; electric feeders on a time clock were set to release feed at 65-second intervals for several hours in three ponds. Self feeders were installed in three ponds to permit fish to feed on demand. Results of this experiment are presented in Table 12.

A list of the various ingredients in three diets is presented in Table 13.

In a series of experiments related to feeding of channel catfish, the following information has been obtained:

(1) Channel catfish have enzymes that are capable of digesting proteins, starches and fats or oils. The greatest secretion is near 75° F.

(2) In force-feeding experiments, the most rapid rate of digestion was near 80 to 85° F. but digestion was only slightly slower at 70 and 75° F. Passage of food was slow at 60° F. and below.

Analyses for content of protein and fats were made on a population of fish during the feeding season and during an eight-months starvation period. The results indicated gain in weight for the channel catfish remained relatively constant for both proteins and fats during the first two-thirds of the season, but toward the latter portion of the season, the relative amount of fats deposited were increased. These fish weighed 10 ounces on the first of September and some fish were placed in indoor tanks where water temperatures were maintained near 70°F. and in an outdoor pond where mean water temperatures were near 58°F. for the next eight months.

Some fish were analyzed for protein and fat content at monthly intervals. During the eight months of starvation, it was determined that they obtained most of their energy by utilizing the fat stored in muscle tissues. More energy was required for the fish maintained at 70°F. and during the latter part of the experiment, they were beginning to utilize some of their proteins. Fish were not severely emaciated at the end of the eight-months starvation period.

These studies indicate that larger (10-ounce) channel catfish can remain in fair condition for at least eight months without being fed.

Table 12. Comparisons of 3 feeding methods with 8-10 inch channel catfish, 1969. 240 per pond, 3 ponds per treatment.

Feeding method	Percentage survival	Grams gain per fish	Lbs. gain per pond	Feed conversion
Hand fed (2.5% daily)	99.7	308	485	2.01
Electric feeder	99.2	277	432	2.20
Self feeders	99.0	229	357	3.83

Table 13. Pounds per ton of various ingredients in diets.

Diets	Z-13B Fry	Z-14 Standard	Z-34 Low an. prot.
Protein %	35	25	25
Energy, Kcals./lb.	956	850	850
Soybean meal (44%)	1044	169.2	706
Alfalfa meal (17%)	224	200	280
Sorghum grain	112	337	310
Wheat bran	200	807.2	460
Animal fat	18		14
Marine fish meal	200	176	5.2
Dist. dried solubles	100	100	100
Ground limestone	23.6		6.4
Dicalcium phosphate	58.4	11.4	73.6
Vitamin premix(1)	10	20	20
Blood meal		37.2	
Meat & bone scraps		132	14.8
Salt	10	10	10
Total	2000	2000	2000

(1) Supplies: 4 grams riboflavin; 7.36 grams d-pentothenic acid; 12 grams niacin; 40 grams choline chloride and 10 mg. vitamin B_{12} per ton of feed.

Catfish Breeding, Selection and Hybridization

John J. Giudice

In 1969, nearly 60 million channel catfish fingerlings were produced for use by the commercial food fish industry. Such production indicates that methods for spawning channel catfish and for rearing fingerlings are now well known. It is time, then, that attention be given to the improvement of the fingerlings that are produced. Improvement in terms of better genetic stocks, improved strains, or perhaps even hybrid **fishes is needed.**

If a mere 1 percent of the above 60 million are deformed or faulty in some other way, a loss of 600 thousand fingerlings having a value of 5 cents each or $30,000 would result.

While the problem of malformations may not seem acute at the present time, the incidence of fish with "bob-tails", closed tail fins, or other spinal deformities is apparently on the increase. In some populations, 50 percent or more of the fingerlings are deformed.

The problem of which we are speaking is genetically related, i.e., the defects are passed on from broodstock to fingerlings in each succeeding generation. It may be due, in part, to inbreeding. The presence of inheritable spinal defects is easily recognized but few producers are taking steps to curb their spread. Other problems which can be attributed to the genetic make-up of fish include uneven and slow growth. These problems are much more difficult to detect than gross deformities and, yet, their effects cause a continual drain on profits.

The channel catfish has repeatedly proven worthy of its selection as a farm animal. As evidenced later in this paper, this species has consistently demonstrated its ability to out-perform not only other species but also most hybrids involving itself and other species. It seems advisable then that we endeavor to improve upon the best prospect we have.

There are several ways to genetically improve a species; all involve some aspect of crossbreeding. This term may be defined as breeding two unrelated forms. The degree to which these forms differ determines the likelihood and degree of success.

Manipulation or control of the mating of animals and plants has often given rise to new forms which have proven themselves worthy for use in their respective industries. For instance increases in growth rate have been observed for several hybrids. Research in the area of hybridization is being conducted at the Fish Farming Experimental Station, Stuttgart, Arkansas and the Southeastern Fish Cultural Laboratory, at Marion, Alabama.

Recent investigations indicate that hybrid vigor can be anticipated in catfish crosses as well as in buffalofish (Giudice, 1964), salmon (Buss and Wright, 1956), sunfishes (Ricker, 1948), and *Tilapia* (Hickling, 1960). These studies showed that 100 percent increases in growth are possible from crossbreeding. Other benefits that might be derived include disease resistance (Snieszko, 1958), improved tolerance to adverse physical or chemical water conditions, and increased ease of harvesting.

It is my purpose to discuss how some of the principles involved in hybridization and selective breeding can be applied to the culture of catfish to improve the species.

"Selective breeding", when applied to our industry and as I shall use the term, indicates a purposeful choosing of individuals from different, unrelated strains of the same species. "Hybridization" will be used to denote the crossing of different species or genera (such as between channel catfish and flathead catfish).

There are seven major catfishes native to the United States. Each of these species possesses some traits which may be desirable (Table 1). No one species possesses all of the traits we would hope to have in the hypothetical or ideal commercial fish. Theoretically, it should be possible to combine the favorable traits of any of these species to produce an improved line of fish.

To date, use of both techniques described above has produced a long list of first generation hybrids and a fewer number of second generation hybrids. In fact, almost all possible crosses involving our major native species of catfishes have been produced in the laboratory. However, in spite of considerable effort, an easy and proficient method of producing large numbers of first generation hybrids on a commercial basis has not been achieved.

Table 1. A comparison of traits of five American catfishes.

	Tolerance of Low Oxygen	Acceptance of Artificial Feeds	Feed Conversion	Dress-out Ratio	Ease of Harvest	Tolerance of Intensified Culture	Growth in First Two Years of Life	Breeding Age in Years	Ultimate Size in Pounds	Ease of Culture	Color of Flesh	Public Image	Other
Channel Catfish	+	+++	+++	+++	+	++	+++	3	15	++	White	+++	
Blue Catfish	+	+++	++	+++	+++	++	+	5	100	++	White	+++	
White Catfish	++	+++	++	++	++	+++	++	1	4	+++	White	++	
Flathead Catfish	+	-	-	+	-	-	-	5	80	+	White	+++	Canni-balistic
Bullheads	++	+++	?	-	+	+++	++	1	3	+++	Red	-	Stunt Readily

- = Poor

+ = Fair

++ = Good

+++ = Excellent

Hybridization

Most hybrid catfish have undergone testing in the laboratory and pertinent data have been collected. Close attention has been given to comparisons of growth rates and feed conversion. Two hybrids appear superior, the white catfish X channel catfish and the channel catfish X blue catfish. The white catfish X channel catfish hybrid has shown a slightly better feed conversion and faster growth rate than the channel catfish X blue catfish hybrid under laboratory conditions.

In replicated pond studies (Giudice, 1966), channel catfish X blue catfish hybrids were stocked with channel catfish and blue catfish. Growth of the hybrids was 22 percent greater than channel catfish and 57 percent more than blue catfish over an 18-month period. When stocked at 1500 fish per acre (500 of each type), the hybrids attained an average weight of 1.1 pounds compared to 0.9 pounds for channel catfish, and 0.7 pounds for blue catfish. At a market price of $0.35 per pound, this would represent $105 more per acre in cash returns when compared to the channel catfish. At 26 months of age, the growth of the hybrid was 32 percent more than that of the channel catfish and 43 percent better than that of the blue catfish.

At first glance these results appear to be most encouraging. However, as indicated above, methods to produce hybrid fingerlings on a commercial scale have not been developed. It is hoped that techniques can be developed as research continues.

As a means of resolving the problem of supply, a study was initiated in which hybrids were mated and the offspring were tested. The first phase of the study provided a comparison of the reproductive capacity between hybrids and channel catfish and the survival of their respective offspring. Weight gains and feed conversions were measured as the second phase of this work. Hybrids were fertile and some fingerlings were produced. However, spawns were usually incomplete and relatively small. The growth rate of the second generation (F_2) channel catfish X blue catfish hybrid was, as expected, inferior to the F_1 hybrid and to the parental stock.

Another approach to solving the problem of production is out-crossing and back-crossing. Out-crossing involves combining features of three or more species as for example, mating a hybrid with a non-related species. The mating of the channel catfish X blue catfish hybrid with white catfish was readily achieved. Resultant fingerlings are currently being tested for survival and growth rate. Preliminary sampling of a mixed population of channel catfish, white catfish, and the above hybrids, in replicate pond tests, shows that the out-cross hybrid also has an inferior growth rate compared to channel catfish.

Back-crossing, the mating of a hybrid individual with one of its parental species, has resulted in fingerlings which are presently 3 to 4 inches in length. Growth rate tests are underway but results are not available at this time.

Selective Breeding

Selective breeding involves improvement of a single species of fish. Certain individuals are chosen as broodstock because they possess desirable features. Size, body shape, color and early maturity are some of the characteristics which may be considered. Briefly, let us consider the steps involved in a selection program.

1. Select the largest males and females in an existing population. The fish should be of the same age, same general stock, and preferably four years old. Remember that size is directly related to stocking density and low stockings may yield large fish which are not necessarily desirable.
2. From these, select the best fish in relation to body form, secondary sex characteristics, and color.
3. Brand or otherwise mark these individuals for permanent identification.
4. Mate the best male with the best female and keep their spawn isolated from all other fish. Repeat this with several other desirable pairs.
5. At the age of one to two months, harvest these fingerlings and select only the largest 10 percent.
6. Return these to the pond and allow them to grow until they are four to five months old when you again select the best 5 percent. Be sure to keep these fish separate from other spawns and stocks.
7. When the fish are 18 months of age, examine them again and retain only the best 5 percent for potential broodstock.
8. At 36 months, select the best males and females and mark them. Consider such characteristics as early appearance and prominence of secondary sex characteristics, desirable body conformation, and color.
9. In subsequent years, mate these individuals with fish produced in the same way from other pairs. Record which fish were mated and keep all spawns rigidly separated so that the best results can be traced to parental individuals.

From the above discussion, it is easy to understand how complex and laborious both hybridization and selective breeding can be. The segregation of individual spawns and broodstock requires the use of many ponds. Both methods require extended periods of time before an evaluation of results can be made. Waiting for fingerlings to reach sexual maturity so that further crossing can be accomplished also requires several years.

Crossbreeding of Strains

In addition to selectively breeding fish within one's own stock, it is possible to use fish from other stocks or strains of the same species as a means to improve fish. More immediate benefits may result from crossing unrelated strains to avoid inbreeding. Working with carp in Israel, Moav and Wohlfarth (1968) have reported that in one generation, inbreeding of full brothers and sisters was responsible for a 20 percent growth suppression. Other effects of inbreeding depression, such as reduced survival and a significant increase in the number of deformed individuals, were also found.

To quote Moav and his workers: "If the experience gained from the Israeli carp population can be generalized, it would seem that the single and simple step of using unrelated mates for production of commercial fry should improve growth rates and yields in many carp growing areas. The use of crossbred fish should also improve and increase uniformity." (Moav and Wohlfarth, 1968).

There is evidence that indicates significant inbreeding has occurred in existing stocks of channel catfish; for example, the increasing numbers of channel catfish with crooked spines, no tails, no eyes, and malformed mouths. Another indication is the wide variation in individual size.

If inbreeding is responsible for the anomalies and variable growth observed in channel catfish, crossbreeding may be a simple, inexpensive means of correcting these conditions. Blue catfish populations have not demonstrated a high degree of abnormalities and show uniformity of growth. A reasonable explanation is that farmers have only recently started to culture this species.

Crossbreeding between strains is by far the most promising for immediate use by the industry itself since fewer facilities are required and the results become evident in a much shorter time. As the term implies, a population is examined and individuals are selected which have shown rapid growth. These individuals are mated with males and females selected from an unrelated strain. The resultant fry frequently demonstrate vigor and increased growth.

The easiest way to adopt this type of program is to trade some of the present broodstock for channel catfish from a totally unrelated source. As an example, obtain broodstock from a state outside the fish farming area; the more distant the better. Perhaps cooperation with another farmer would permit an exchange of fish, thus benefiting both parties. If inbreeding has already occurred, crossing of the two strains should restore vigor.

The process of crossing strains should be as follows:

1. Upon receipt of the unrelated strain, the fish should be marked, either by branding or other means, for permanent identification.
2. Cross females with unrelated males and vice versa. Present methods of spawning may be used; either in pens, aquaria, or open ponds.

Crossbreeding of strains, because of the ease with which it may be carried out and the speed with which results are obtained, could be adopted by the fish farming industry with little expense. In most cases, farmers already have the required facilities.

In retrospect, our work with hybridization to date indicates that the fish farming industry should concentrate its efforts not only toward improving the growth rate of catfish but also the correction and prevention of anomalies. Proper use of techniques of crossbreeding may, in the future, develop fish with higher dress-out ratios, increased disease resistance, improved tolerance of adverse environmental conditions, earlier spawning, or perhaps, even loss of spines.

The task of hybridization must continue in order to explore all possibilities of producing a better animal but this is a job for research biologists.

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Observations on Diseases of Catfishes

Fred P. Meyer

Disease control in warm-water fish culture has long been a poorly studied subject. Fish farmers are often unaware of disease problems until mortalities occur. Only then will an effort be made to determine the nature and extent of the problem. Some diseases, such as those due to external parasites, may have a chronic or lingering pattern of development. Others, such as bacterial infections, may cause catastrophic losses within 48 hours after the first fish die.

Good fish cultural methods must, therefore, include regular, daily observations for any sign of disease or for conditions which may lead to disease. Prevention, not treatment, holds the key to a successful disease control program.

Concurrent with the need for prevention is a need for methods to prevent the spread of diseases which are capable of causing catastrophic losses to the industry. In trout culture, this would include such diseases as Infectious Pancreatic Necrosis (IPN), Infectious Haemopoetic Necrosis (IHN), and whirling disease. In catfish culture, I would place the channel catfish virus in this category along with one form of a myxosporidian which develops in the interlamellar gill spaces. Both of these diseases cause major losses of young fingerlings. Ideally, any population of fish found to carry these diseases should be quarantined and destroyed to prevent their spread to other farms. The owner, however, should be indemnified to protect him from a personal financial disaster resulting from efforts to protect someone else. Legislation in this area is urgently needed - similar measures have long been in effect in the cattle, swine, and poultry industries.

Bacterial Diseases

The control of bacterial diseases of warm-water fishes in North America is a comparatively recent undertaking. Prior to 1950, most efforts to control fish diseases of bacterial origin centered on quarantine, pond sanitation, and improved management techniques. In some areas of the United States, losses due to bacterial infections were considered routine, and deficiencies in production were generally offset by stocking extra breeding stock. While partially successful, such techniques were accompanied by numerous other problems such as overcrowding and starvation.

Hemorrhagic septicemia, a systemic infection of fish caused by *Aeromonas liquefaciens*, is generally considered to be the most important bacterial disease of warm-water fishes. This disease has been identified from all species of fish checked thus far at the Fish Farming Experimental Station (Meyer, 1964) and has been responsible for extensive losses throughout the country (Snieszko, 1954; Griffin and Snieszko, 1951). Although taxonomists may yet disagree as to its correct taxonomic position, there can be no doubt as to the virulence of this organism.

Aeromonas liquefaciens infections are most prevalent during June, July, and August, but a peak is also noted in April. This two-peak occurrence reflected differences in hosts. Outbreaks in April are usually associated with spawning activity of broodstock golden shiners but may also reflect temperature stresses as suggested by Snieszko (1954). Epizootics in June, July, and August involved catfish in rearing ponds and coincided with periods when oxygen levels were lowest. The bacterial infections occur from ten days to two weeks following the period when the fish are under the stress of low levels of dissolved oxygen. While total depletions cause mortalities due to suffocation, oxygen levels of three ppm or less will cause severe stress (McKee and Wolf, 1963). Low oxygen stress is considered to be a major factor in outbreaks of *Aeromonas liquefaciens* during summer months. The occurrence of these outbreaks only in rearing ponds gives a further indication of the relationship to water conditions in the ponds. Low oxygen levels in ponds pass unobserved on many fish farms and the role of low oxygen in initiating bacterial infections is often unsuspected.

Myxobacterial infections present another type of bacterial disease which is common in warmwater fish. Diagnosis of columnaris disease in fish is usually based on the presence of myxobacteria in typical external lesions on the mid-dorsal areas of the body or in mucus membranes such as those in the mouth region. Such symptoms have given rise to descriptive names for the disease such as "saddleback disease" or "cotton mouth disease".

Unfortunately, these symptoms, although usually typical of columnaris disease, may be produced by a variety of pathogens. Consequently, it is difficult to ascertain positively the correct identity of the causative organism unless bacteriological examinations have been made.

The apparent fastidiousness of the pathogen (Chondroccoccus columnaris) has made isolation difficult. Certain laboratories have reported repeated success in the isolation of this organism but others, such as our laboratory, have failed in the artificial culture of this bacterium even on media used successfully at the other stations. This diversity of results may be due to a number of factors; differences in strains or species of bacteria, rigid requirements as to its optimal thermal range, or perhaps to a completely erroneous diagnosis of the disease. The variable degrees of success with which reported cases of this disease have been treated also suggests that this disease and its pathogenic agent are, as yet, poorly defined.

Outbreaks of columnaris appear to be related to unfavorable environmental conditions such as low oxygen levels or accumulations of metabolic by-products. Though it is most frequently encountered during the hot summer months, the disease occurs throughout the year. In each case, when winter infections have been observed, ice cover remained over heavily stocked ponds for several weeks. As the ice receded, heavy mortalities due to columnaris occurred.

Channel Catfish Virus

The channel catfish virus disease has now been studied in sufficient detail that a few remarks can be made concerning it. The virus is a "Herpes-type", similar to that which causes cold sores. It can be transmitted through water or with food. Although we are uncertain as to how virus particles escape from infected fish, we now suspect that the urine is the most likely route. Fecal transmission or gill excretion, however, has not been ruled out.

The disease bears many resemblances to IPN disease of trout. It is most virulent to very young fish, especially those in the two to three inch size range. Fish up to six inches are susceptible but larger fingerlings appear to be more resistant. Likewise, fish of one year or more in age seem to have an increased resistance. If these observations prove true, the virus will be a problem only to fingerling producers. A great deal more work is needed to determine the accuracy of these observations.

At the present time, methods have not been perfected which will identify asyptomatic "carriers" of the virus. Such methods are a must before any type of control program can be initiated. Until this capability is achieved, quarantine and destroy techniques present the only way to limit the spread of the virus.

Protozoan Diseases

The impact of protozoan diseases of warm-water fishes on fish culture is well recognized. Nearly all stations concerned with the production of fry and fingerlings now realize the importance of controlling this group of parasites. Even moderate numbers of these organisms on small fish may prove fatal since the infections may cause the fish to stop feeding. Fry and very small fingerlings cannot survive for any extended period without feeding, so infected fish may die without exhibiting any symptom other than debilitation. Symptoms are usually not striking and the behavior of the fish is as useful in recognizing infections as is physical appearance. A notable exception occurs, however, in the case of Ichthyophthiriasis. Parasite-infected fish may exhibit over-secretion of mucus, with the accumulated slime giving the fish a grayish or bluish appearance. Nervous twitching of the fins or body, scratching on any surrounding object, folding the fins, loss of appetite, loss of balance, erosion of the fins, and petechiae in the fins are frequently observed symptoms.

The seasonal incidence of protozoan problems emphasizes their danger to young fish. Trichodina, in particular, is a dangerous parasite. Ichthyophthirius may cause extensive losses if it is not detected in its early stages. Scyphidia occurs commonly and may pose problems. Costia and Chilodonella also present problems but their incidence is lower than the three listed above. A more complete discussion of protozoan parasites and their effects on fish culture may be found in Meyer (1970).

One protozoan disease should receive further discussion. A myxosporidian parasite has been known for some time which forms cysts in the interlamellar gill spaces. Heavy infections of this parasite result in the destruction of over 95 percent of the gill surface area. Nearly complete losses have been recorded in fish less than 14 days old. Unfortunately, fish with a moderate infection may survive and will transmit the parasite to other areas when they are stocked. Its spread in recent years has been evident in cases which pass through the diagnostic laboratory of the Fish Farming Experimental Station and it is now known from Missouri, Arkansas, Mississippi, Alabama, Oklahoma, Texas, and Kentucky.

As in the case of the channel catfish virus, we have no control methods other than to quarantine and destroy infected fish.

Helminth Parasites

Monogenetic trematodes constitute the major helminth menace to fish culture in the United States. Gyrodactylus, Dactylogyrus, Cleidodiscus, and a host of others have been recognized as serious problems to fish culturists. It is not the purpose of this paper to enter into a taxonomic differentiation of the various forms which attack our warm-water fishes. A few remarks, however, are in order concerning the way in which infestations of these organisms are manifested. Forms which inhabit the body surface, such as Gyrodactylus, may evoke a variety of symptoms. Some fish will attempt to scratch themselves by scraping the body against any surface in the environment. This response is similar to that induced by penetrating tomites of Ichthyophthirius. Frayed fins, secondary fungus infections, and petechial hemorrhagic areas may be observed in such fish. Other fishes such as the golden shiner, may congregate in the shallower areas of the pond and may be observed swimming around the margin of the pond in large masses.

Flukes which attack the gill surface, such as Cleidodiscus or Dactylogyrus, may cause destruction of the gill epithelium or loss of blood. Fish infected with monogeneans may become anemic or may exhibit symptoms of anoxia associated with the intense gill irritation which accompanies the feeding and activity of the helminths.

Digenetic flukes cause much concern to the American sportsmen and fishery biologists. Much of this concern is generated by the fact that encysted metacercariae, known as "grubs", are obvious even to the untrained eye and a lack of knowledge concerning the organism involved has caused the public to look with apprehension on these forms.

With the exception of producers of bait fishes or ornamental varieties, digenetic flukes have not caused serious problems to the fish culturist. In these species, the unsightly condition resulting from the presence of the encysted larval stages has rendered the individual fish unsuitable for market. The sportsman who encounters a grubby fish will generally discard it as being unfit for consumption. While this is untrue, it does not affect him materially in the sense that it represents a loss of income or in the loss of food urgently needed for his table. The commercial producer of food fishes such as channel catfish will be unable to indulge in such extravagance.

Tapeworms and nematodes have not presented problems thus far in fish farming ponds. Although they are sometimes observed, they have not been shown to have harmful effects on growth or feeding efficiency.

Parasitic Copepods

Parasitic copepods once caused great economic losses to fish farmers. Lernaeid and argulid parasites of minnows and goldfish still cause extensive losses annually due both to mortality and to disfigurement which renders the grown fish unsuitable for market.

Lernaea cyprinacea, in particular, presents the most serious problem due to its apparent lack of host specificity (Putz and Bowen, 1964). Although scaled species are most susceptible, smooth-skinned fishes such as catfish are also vulnerable to attack. Sites of attachment are usually accompanied by acute hemorrhagic reactions which frequently become foci for secondary infections by bacteria or fungi. Infestations due to L. cyprinacea may evoke a variety of behavior patterns from fish. If the parasites are attached near nerve centers, such as the brain or along the lateral line, infested fish frequently will swim in a tight circle or exhibit convulsive movements when frightened. Heavily infested fish quickly lose stamina and may suffer loss of balance, frequently swimming upside down or hanging vertical in the water in a moribund condition. According to Putz and Bowen (1964) the parasites cause hemorrhage, ulcerous wounds, retardation of growth, loss of weight, changes in the numbers of blood cells and death.

The fish louse, Argulus sp., is occasionally responsible for epizootics in natural waters. Producers of goldfish and carp report difficulty with this parasite but it has not been a problem to minnow raisers or other fish farmers. At our station one case of Argulus has been identified in the diagnostic laboratory in nine years.

Achtheres sp. and Ergasilus sp. are encountered on wild fishes in many host-parasite studies. Their incidence in such situations is usually low but under unusual circumstances, heavy parasite burdens can develop. I have had occasion to examine specimens from several fish hatcheries but I feel that these parasites, too, are primarily only of academic interest at the present time.

Other Diseases

Diseases known to be due to nutritional deficiencies have not been considered in this paper. Although work in this area related to warm-water fishes is limited, it is definitely known that nutritional diseases occur. As an example, a thiamine deficiency was observed in fingerling flathead catfish being fed a ration of fresh carp flesh and artificial feed (Giudice, 1963).

Disorders due to poisoning with industrial or agricultural chemicals likewise have not been discussed. This area represents an entirely new field and frequently involves subtle changes in the histology of organs or of the blood picture. In recent months increasing numbers of pesticide related problems have been encountered. Diverted agricultural acreages with histories of heavy insecticide applications are proving unsuitable for use in raising fish. Many of the pathological conditions associated with poisonings of this nature are not known.

Oxygen depletions (anoxia) due to excessive blooms of algae or due to over-feeding have not been considered. The increased production of food fishes in the United States will lead to an increase in mortalities due to this cause. The conditions leading to such oxygen deficiencies are not discussed here even though catastrophic fish losses may result.

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Plannning Requirements for Fee Fishing Ponds

Robert C. Summerfelt

INTRODUCTION

Recreational fishing produces an economic product since people are willing to pay for it. A monetary value can be assigned to the tangible recreational services provided by the enterprise. Expenditures for goods and services include those for baits, tackle, boat rental, food and beverages, and license fees. In addition, fishermen spend money for goods and services to reach the site for gasoline, food and lodging. In 1965, American fishermen spent 2.9 billion dollars on a multiplicity of goods and services (1965 National Survey of Fishing and Hunting). Expenditures for fishing have an important impact on the U.S. tourist industry. In Michigan, even before the successful introduction of coho salmon, expenditures for fishing generated 100 million annually (National Agriculture Chemicals Association, 1968).

The purpose of this report is to point out that fishing is a marketable entity. Commercializing on sport fishing is not new; merchants in sporting goods, boats, motors, bait, guides, and so on, have profited from fishermen for a century or more. Fee fishing, however, is a newer, more obvious form of commercialization where fishing is the product.

The expansion of fee fishing in the near future depends upon the rate of expansion of outdoor recreation in general, and the development of fish farming. Expansion in outdoor recreation is dependent upon rising income, more leisure time, increasing mobility, and rapidly increasing population. The number of people seeking recreation in fishing continues to rise at a faster rate than the rate of population increase. A recent Rutgers University study indicated a 21% increase in the number of people fishing from 1980 to 2000, compared to a 19% decrease in the number of persons hunting (Johnson, 1970). A 50% increase in the number of fishermen was predicted from 1962 to 1976 (King, Swartz, Hemphill and Stuzman, 1962). They anticipated that a large portion of the increased fishing pressure would be absorbed by marine and tidewater areas, but freshwater areas will also experience greatly increased rate of utilization throughout the coming years.

This report hopes to encourage expansion of opportunities for recreational fishing. Fishermen are suitably motivated for use of fee fishing (Summerfelt, 1968), and considerable interest exists for use of recreational fishing as a market outlet for trout (McLeary, 1969; McCullough, 1970). The profit motive may encourage the development of more fishing opportunities than would otherwise be possible. However, the prospective fish pond entrepreneur needs guidelines as well as encouragement. Also, the fish producer should be aware of the character of this type of market for his farm-reared fish.

RELATIONSHIP TO THE CATFISH INDUSTRY

Recreational fishing has been identified as an important factor in maintaining high price levels for farm-reared catfish (Jones, 1969:5). In 1969, catfish sold to processing plants averaged 35 to 40 cents, whereas producers received up to 55 cents per pound for catfish sold to recreational fishing lakes, sportsmen clubs, or municipal recreational put-and-take fishing lakes. Recreational fishing lakes can provide the best market for catfish producers too distant from processing plants or in other cases, they provide an outlet for producers who can not produce catfish of sufficiently uniform size for the processing plant.

There is a real need for catfish producers specialized in producing fish for the fee pond market. Production costs may be higher because fish are needed at frequent intervals, but higher profits can compensate for this. Cage culture or raceway culture of catfish may offer the best approach for this market because small lots (1000 - 5000 pounds) can be harvested on short notice without disturbing the other fish.

COMPARISON OF THE CATCH-OUT POND AND PUT-AND-TAKE POND

The catch-out pond may be a farm or ranch pond, or a pond specially designed for fishing. Intensity of management can vary from nearly zero to a program involving fertilization, stocking, supplemental feeding, weed control, annual draining, and others. Fertilized Alabama ponds have provided 150 to 200 permit sales annually

(Prather, 1958). Prather (1958) reported that this provided $500,000 income to 2500 ($200 each) Alabama pond owners in 1957. Average returns to management and labor was $433 per unit (not per acre) in bass-bream catch-out ponds in Alabama (Driscoll and Kern, 1966).

Similar types of rural catch-out ponds in Arkansas averaged $321 (Jordan, 1963) per unit, in Oregon, $391 (Holmes, 1964), and in Ohio, $339 (Owens, 1964). Thus, they produce only a supplemental income for family labor and some return for small investments. The most profitable lake size was 15 to 30 acres, and fishing was generally best in the first year. Lake construction was rarely paid by the farmer for the purpose of making a profit. These ponds generally offered few facilities and few were covered by liability insurance.

Catfish can be reared in upland ponds receiving only runoff water (so-called "sky ponds") either alone or in combination with other fishes such as in combination with the standard bass-bluegill or redear sunfish combination, or with bass and fathead minnows. The former method, with precise stocking ratios in newly stocked, well fertilized ponds, can produce 75 pounds of catfish in addition to the normal catch of bass and sunfish (Prather, 1964). Also, these ponds can be used to produce bass or other sport fish for stocking a put-and-take pond, or the producer may wish to sell the product to other fee operators.

In Alabama catfish ponds, Prather (1959) reported catch rates of 0.2 to 2.8 fish and 0.42 to 2.90 pounds of fish per fisherman-day, when total fishing pressure was 579 fisherman-days per acre a year. With a stocking rate of 2000 fingerlings per acre, 1241 catfish (60% of the number stocked) weighing 1292 pounds, were caught in 12 months of fishing (Sept.-Dec., March-Oct.). When the pond was drained, an additional 9% were captured but natural mortality was found to account for 29% of the total number stocked. This mortality was 20% higher than normal presumably due to fishermen releasing injured fish. About 50 to 100 largemouth bass fingerlings may be added per acre to provide additional fishing and serve to control green sunfish. Driscoll and Kern (1966) studied four of five commercial catfish ponds in Alabama. The average size was 19 acres, and operators usually maintained two or more ponds simultaneously. Three of four operators interviewed reported their facilities utilized to capacity in peak periods. Fish were reared in the pond used for fishing. Average net return to management and labor was $134 per acre.

Fee fishing ponds must provide consistently good catches or business will fail. Monthly catch-rates in catch-out ponds varied 14 fold in the Alabama study reported by Prather (1959). Some variation is due to declining densities of fish available to the fishermen and also to seasonal factors including temperature and rainfall. In catch-out ponds with bass-bluegill sunfish combinations, catch-rate declined with decreasing population densities. In a bass-bluegill pond during the first year, heavy fishing often results in removal of 50% of the total annual harvest in the first few days. Dunn (1968) reported a harvest of 24.5 pounds per acre the first day, and 118 pounds per acre in the first 11 days of a newly opened 94-acre Alabama lake.

When fishing becomes poor in catch-out ponds, the remaining fish may be removed by seining or draining and the pond prepared for rearing a new crop. If multiple ponds are available, the pond operator can close one when population density declines and open another to maintain good fishing. This was a procedure used by one Alabama catfish pond operator (Driscoll and Kern, 1966:14). Successful catfish fishing may be maintained for 8 months of the year in South Central U.S., or 6-7 months in the North Central area. Water temperatures above 60 F. define the fishing season because below this temperature feeding and catchability of catfish is reduced. Driscoll and Kern (1966) stated that catfishing ponds in Alabama had a season of 5 to 6 months. I believe that in the South Central U.S., suitable pond temperatures are available from April through October. Since capital investments are fixed, year-around operations can reduce overhead costs. Fishing can be continued by a 5-month rainbow trout fishery. It is also necessary to close in off-seasons, or when the weather is poor. Remaining open day after day in inclement weather can sharply reduce profits.

Catch-out ponds may suffer from the disadvantages of poor location, lack of facilities, construction and management problems which are not conducive to providing a good recreational experience. Fish farms must be located where desirable soils, water supply, drainage and other production needs can be met. Upland ponds need large watersheds in order to maintain water level. The construction and landscaping of catch-out ponds may be designed to suit economical production needs and not to provide pleasurable fishing, aesthetics, picnicing and family recreation. Factors desirable for production may make the site inconvenient to the potential fishermen. Distance from the patrons could be a major problem.

The statistics gathered to date verify that the catch-out pond is only a supplement to farm income or to complement other types of broad-based recreation enterprises, but it is not a full-time business enterprise.

A <u>put-and-take pond</u> is one stocked with catchable-size fish which are ready for harvest. In this case, the pond is designed for fishing rather than production of fish. It is stocked with fish at heavy densities at intervals frequent enough to maintain a high catch rate. Fish are purchased or reared by the owner. It is a capital intensive enterprise, but is geared to year-around fishing which can provide a basis for a complete business producing returns to investment and labor of $10,000 to $20,000 per year. Planning requirements are greater and are prepared with the intensive fee fishing pond in mind.

PLANNING REQUIREMENTS

There is more to fee fishing than providing fish. A successful fee fishing establishment must develop and maintain many services. Outdoor recreation should be geared to appeal to the family which demand more services and better quality facilities. Fishing functions as the mainline attraction in fishing ponds, which permits the marketing of bait, boats, fishing tackle, and refreshments to a somewhat captive audience.

Major planning requirements include predicting demand, location, fees, fish, insurance and statutory rules and regulations.

Predicting Demand For Fee Pond

Correctly predicting demand reduces the percentage of failures in private fee fishing developments. One of the most important questions confronting the potential operator is what will be my average annual patronage?

Demand is obviously related to the density of human population, or more specifically, to the density of that portion of the population which has some inclination (requiring leisure time and money) to fish. In 1965, 20% of the total United States' population were classified as active fishermen because they either fished part or all of 3 days, or spent over $5.00 to go fishing (1965 National Survey of Fishing and Hunting:ii). The same survey indicated that regionally this varied from 10.1% in the populous Middle Atlantic states of New York, New Jersey and Pennsylvania, to 27.6% in the West North Central states (Minnesota, Iowa, Missouri, North and South Dakota, Nebraska, and Kansas). The wide variation is related to income, available leisure time, and access to fishing. The percent of the total population which fishes is lower in big cities (12.0%) than towns and rural areas (23.5%). I believe that if residents of the inner city (core) of our large metropolitan centers were offered fishing opportunity, more people would fish.

The portion of the entire population in any area which regularly fishes may be the best single indicator of the potential market. However, regardless of whether we use the total population, or the population of fishermen, the big question is what fraction of the total can be expected to use a fee fishing facility. I propose in the following paragraphs to show the logic of two estimators which seem to have some merit.

Lopinot (1966) reported 340,261 patrons for 112 Illinois fee fishing areas. These fishermen returned an average of 9.8 times during the year indicating 34,720 individual patrons. Illinois in 1965 had a human population of 10.65 million, and Illinois fishing license sales were 671,941. Fishing license sales comprised only 6.3% of the total population. Patronage of the fee fishing ponds comprised only 5.2% of the licensed fishermen, but this does not mean that 5.2% of the licensed fishermen did patronize the ponds. Although 19% of the population may be classified as fishermen, only a portion will be licensed. A large number of people (young, retired, military, etc.) fish without licenses. According to the 1965 Survey of Fishing and Hunting, 19.0% of the total human population fished in the East North Central division which includes Illinois. The percentage of individual patrons to Illinois fee fishing ponds in 1966 was only 1.7% of the fraction of the population which presumably fished in Illinois in 1966 (19% of 10.5 million).

The Illinois data, assuming 1.7% of the estimated number of fishermen, or 5.2% of licensed fishermen, was used to test the applicability of these percentages to our Oklahoma pond.

In the first year of operation (actually a ten-month period from December 7, 1968 through September 1969), the Lake Carl Blackwell fee fishing pond (2.5 surface acres) had 760 different fishermen who fished 6.8 trips each. Of these persons, 53% were from the city of Stillwater, the closest municipality, which is located 10 miles from the site. Stillwater had an estimated population of 34,230 of which 25.8% were assumed to be active fishermen (1965 Survey of Fishing and Hunting, data for the West South Central U.S., Table 38, p. 66). This fraction represents 8831 potential customers of which 402 individual patrons (4.6%) actually used the LCB fishing pond. This indicates that the 1.7 percentage using the Illinois fee fishing ponds, underestimated the success of this fishing pond. In 1965 about 18% of Oklahoma's total population (2.46 million) purchased resident fishing licenses (459,665). Applying this percentage to Stillwater's 1965 population of 32,000 indicates approximately 5760 licensed fishermen. The Illinois data indicated about 5.2% of licensed fishermen patronized their fee fishing ponds. Applying the 5.2% to the 5760 Stillwater fishermen, we obtained an estimated 300 patrons. The actual number was 402 patrons, or 7.1% of the licensed fishermen. Both forms of data from the Illinois ponds applied here resulted in underestimates, yet they were reasonably close.

This is still somewhat complicated and requires data on both population density, number of license sales, and a good estimate of the percentage of the population inclined toward fishing. A simplification would be to relate utilization directly to population size. Illinois had one fee area per 93,700 people. In 1963, Alabama had 290 bass-bream areas and 12 catfish ponds. Thus, they had one bass-bream pond per 11,665 people, or, combining catfish and bass-bream ponds, they had one fee pond per 11,202 people. Missouri has excellent data on the number of fee ponds because they are licensed by the Department of Conservation. In 1969, they numbered 178 while Missouri's population (U.S. Bureau of Census, 1969) was 4.625 million. The number of licensed fish ponds was one per 27,528 people.

Thus, on a population basis, the estimates were one pond per 93,700 in Illinois, one per 11,202 in Alabama, and one per 27,528 in Missouri. As a general rule, one per 50,000 resident people might be a reasonable expectation. In areas of low population density but heavy tourism, the estimate will have to be modified.

Location

Proximity to Centers of Population. - Success depends upon the number of people using the facilities and the money they spend at the site. Location should be near a population center or near well-traveled highways which carry tourists and have good access.

Continuous heavy attendance can spread operating costs, keeping the pro-rata charge per angler-day at the lowest level. Heavy sustained fishing is essential, otherwise, the fish will not be fully harvested, the service costs per angler will rise and the operation will slump into financial collapse. A self-supporting fishery can expand to meet growing demands without financial strain, if it encourages heavy patronage. Declining attendance creates serious problems when the enterprise must be supported by very few patrons.

The percent of residents in big cities which fish is only 12% compared to 19.1% in small cities and 23.5% in towns and rural areas. Fee fishing can provide instant fishing in areas of population concentration. The 88% of urbanites who do not fish represent a huge potential market for fee fishing if we can bring fishing closer to their home. For residents in a large city, fishing sites are frequently far out of town and too difficult and time consuming to reach for frequent visits. The lack of opportunity to participate, rather than a lack of desire, apparently reduces participation. When the inexperienced fisherman, whether city dweller or rural resident, does fish, poor success will discourage further participation.

Fee fishing in urban areas is a way to make fishing convenient and permit even the novice the opportunity to experience the pleasure of successful fishing. In the Illinois study by Lopinot (1966: 3) the recommended requirement for operating a successful fee fishing area is location within 25 miles of a metropolitan area: 63.7% of the fishermen using the areas traveled 25 miles or less. Twenty-eight of thirty-nine bass-bream lakes in Alabama were within 30 miles of population centers of 10,000 or more (Driscoll and Kern, 1966: 5). Factors, such as quality of facilities, personality of operators and promotion can compensate for good location, but as a rule, it should be within 25 miles of a major tourist area or a population concentration of 50,000.

Proximity to Alternate Recreational Outlets. - Consideration should be given to competitive enterprises which in the rural areas may include availability of alternate fishing sites such as farm ponds, state lakes and reservoirs. Fishing should be able to compete for the family recreation dollar if it can provide a satisfying recreational experience. Proximity to popular attractions can increase exposure to the public, therefore, alternate recreational outlets are not always competitors but serve to concentrate potential patrons.

A successful recreational area will need to provide rest room facilities, including sinks, flush toilets and electricity, landscaped areas, picnic ground, benches, hard surfaced paths and diversions for the younger children. Visual aspects of water quality and scenic characteristics of the area are paramount.

It must provide better fishing, a unique fishery, and better facilities than is provided by public fishing waters. The public does not like to rough it, and they demand quality facilities, and a good catch rate.

It requires a good manager of both human and physical resources. Management of an intensive type fishing pond, with alternating catfish and trout will be a demanding position. It will require long hours and skill in fish husbandry and pond management.

Fees

As everyone knows, retail prices of most items fluctuate considerably, and the easiest way to outdate my comments would be to define what prices should be charged. In some cases, fish may be sold at cost as an enticement for other sales. Moreover, prices may be proportionately higher for tourists, or affluent patrons which are provided exclusive fishing privileges or country club atmosphere, trophy size fish, and special services. However, reuse by local patrons will be significantly discouraged by fees considered excessive. It is imperative to determine what is an acceptable fee and what is considered excessive.

In most catch-out ponds, the daily admission fee is the only charge. Driscoll and Kern (1966) found that a $1.00 fee was charged by over 80% of the Alabama fee operators in the bass-bream catch-out ponds. Sometimes a limit is established on the catch and any fish taken in excess of the limit are paid for on a per pound basis.

Perhaps a fee can be related to what is the current local retail price for the same species. If frozen catfish sells for $1.25 per pound in the grocery, the fee at the pond may be similar. In the intensive type of put-and-take pond, most operators charge by the pound, usually $1 to $2. This is the most acceptable system because the owner usually buys the fish by the pound. Also, some operators use a modification of this system and charge by the inch. Measurement eliminates the need for scales which must have annual state inspection. However, it is generally less satisfactory for both management and patrons. A supplemental admission fee is often used to be sure that even the fishermen who fishes poorly pays for use of the facilities. If kept small, less than $1.00, the admission fee supplements total income without raising the obvious price per pound to an excessive level.

Ultimately, the price charged to the patron must be related to the price paid by the operator for the fish and total overhead costs. The operator is forced to secure the fish, as he does with other items sold, for the lowest price. It is expected that he will, with adjustments for mortality, obtain a reasonable profit on the fish by an appropriate mark-up. Mortality of adult fish used in a fee fishing pond may average 10% requiring a mark-up for profit in the order of 30 to 40%. However, this may have to be considerably larger if sale of fish rather than admission and other services, is the principal source of income.

Fee Schedule Used in an Oklahoma Fee Pond

Admission--the fee is 50 cents for adults and 25 cents for children under 12. The admission charge is for the entire day. If the patron has to leave, he may be readmitted later the same day without additional charge.

Price of fish--We initially charged 40 cents per fish (for trout) regardless of the length or weight of the fish. If fish of the right size are stocked, it can be more profitable and easier to manage since fish will not have to be weighed. However, it does lead to sorting by the fishermen, and smaller fish are returned to the lake. Also, this practice sometimes created ill will when discrepancies in size led to situations where similar payments were for greatly different weights of fish. Our present price structure for trout is $1.12 per pound in the round, and $1.28 dressed weight. We dress the trout free of charge. Catfish are sold for $0.80 per pound in the round, and $1.28 dressed weight. We charge 25 cents fee for dressing catfish for which the fishermen paid 80 cents round weight. In the latter case, the fisherman sustains the weight loss due to dressing and pays us 25 cents per fish.

Returns of unwanted fish--Some fishermen do not want to purchase their fish. Our patrons include a large number of college students who cannot prepare their fish because they live in a college dormitory. However, they patronize our pond because we allow them to turn in their fish for 20 cents each (originally 10 cents). Thus, they can enjoy the pleasure of catching 5 trout or catfish for $1.00 plus the 50 cents admission. We dress the fish which they return and sell them out of our freezer to individuals, restaurants, or supermarkets. Two trout which average 0.5 pounds will yield 40 cents when returned to us. Assuming a loss of 25% of their body weight by dressing, we will have three-quarters of a pound of fish which we sell for $1.28 per pound (.75 pound = 96 cents). Our gross income from the two fish (one pound) then equals $1.36 for which we paid 80 cents, or a gross profit of 56 cents per pound (not including 50¢ admission fee). This is better than a gross profit of 32 cents per pound for fish sold in the round (40% mark-up) at $1.12 per pound. However, if the producer ships us a lot that averages one pound, then gross profit will only be 36 cents per pound.

Fish

Differences in environmental requirements, handling, mortality, catchability, feeding and diseases are important factors which need to be considered and their specific characteristics described.

Catchability will vary with species. For a species it will also vary daily and seasonally. Steady income is not possible with a fish with fickle biting habits. Considerable discussion prevails among professional fishery biologists about the relative catchability of channel, blue, and white catfish.

Size is important, the most desirable size fish needs to be evaluated in terms of the preferences of the fishermen. Generally, fishermen want the largest fish possible, but larger fish are usually more expensive to purchase. We observed an obviously better response of fishermen to trout one-half pound or better, than to trout less than one-half pound.

Large size, although not necessarily trophy size, attracts anglers. They also shorten the time the fishermen can fish because a catch of one large fish quickly cuts into the patron's pocketbook. Variation in size is important to heighten interest. Where most fish are of small average size, a few large fish are of importance to increase interest and satisfaction.

Source of Fish. - Distance from source increases cost of fish delivered to a fee pond. Although, up to a point, the price will vary with the quantity ordered, and lower per pound prices can be obtained with larger orders, there is still a conspicuous limit. The example in Table 1 (assuming transportation costs of 50¢/mile) shows the relationship between distance hauled and price per pound.

Table 1. Costs of purchasing fish relative to distance required for shipping. Example assumes 2,000 pounds of fish, 50¢ per pound purchase price for fish, and 50¢ per mile round trip shipping cost.

Round trip distance in miles	Trans-portation costs ($)*	Cost of fish + transport.	Price/lb (fish @ 50¢/lb + transp.)	Cost of transp. as % of total cost
50	$ 25	$ 1,025	51	2.5
100	50	1,050	51	4.8
150	75	1,075	54	7.0
200	100	1,100	55	9.0
250	125	1,125	56	11.1
300	150	1,150	57	13.0
350	175	1,175	59	14.9
400	200	1,200	60	16.7
450	225	1,225	61	18.4
500	250	1,250	62	20.0

*Fifty cents per mile round trip, or one dollar per mile one way.

These figures show that transportation costs make up an increasingly larger percentage of the total price paid for fish with increasing distance from the source. For this reason, fee fishing can provide a good market outlet for fish farmers outside areas of intensive catfish production. Catfish farmers outside the Mississippi Delta can be competitive for the live fish market for some time, even though they cannot compete for the restaurant or frozen food market because of higher production or processing costs. Sometimes, however, producers outside the areas of intensive catfish production charge very high prices and it may be more advantageous to truck-in the fish in spite of higher transportation costs.

Influence of distance on condition of the fish. -- Other things being equal, the farther fish are transported the poorer their condition will be upon delivery. No exact measure can be assigned since the well-being of the fish depends on their handling by the producer, the manner in which they were crowded for shipment, effectiveness of aeration, and cooling.

Availability of Fish. -- Most producers are reluctant to harvest in the summer when water temperatures are high and mortality may be considerable. However, this coincides with a period of optimum harvest by sport fishermen. The fee-lake operator must be prepared by stocking heavily in fall, winter or early spring, or by maintenance (at added expense) of ponds to carry over an inventory of fish for the summer period. Prices of fish may also run higher in the summer than other periods. Trout producers on the other hand, because of the use of raceways, are generally able to supply customers on shorter notice, and usually are able to supply fish throughout the year. Perhaps with the development of raceway or caged culture for catfish, deliveries can be expected throughout the year at a uniform price.

Stocking Density. -- A fee fishing operator needs (for his very survival) to maintain good fishing ("unusually successful fishing") which can only be sustained by continuous, heavy stocking. It is important to have a good catch rate (frequent catches per hour), "lots of action," and also a large total catch. In Murray Lake, California, one pound of trout was stocked per angler day of fishing, to maintain a catch rate of approximately one pound per angler day. This satisfied the anglers while permitting reasonable fees ($1.00 to $1.25/day).

Catch rate varies with the density of fish and other factors affecting the catchability of the species. It is important to provide good fishing and to have fish eager to bite.

Fish stockings should be at levels determined to provide maximum catch rate compatible with maintenance of suitable oxygen and other water quality criteria. Successful trout fishing may be maintained at densities of less than 50 pounds per acre (Ball, 1967), whereas, successful catfishing, even under ideal water temperatures, may require 1000 pounds per acre to sustain a catch rate which both satisfies fishermen and the income requirements of the operator. In Illinois fee fishing establishments, 2,000 to 6,000 pounds per acre were stocked periodically on a put-and-take basis. The average recommended weight of catfish to stock was 1,466 pounds per acre (range 80 to 20,000 lbs/acre) (Lopinot, 1966). Because of the danger of oxygen depletion or direct toxicity due to accumulation of waste products, densities above 3,000 pounds per acre should not be maintained without a supply of water to flush out excessive nutrients and waste products. Where densities are maintained at high levels, there is probably little hope of growth unless a large volume of water is used to flush the pond. Catfish may bite poorly when water temperatures are below 60 F, and rainbow trout may bite poorly when secchi disc turbidities are less than 18 inches, or when water temperatures are lower than 34 F. or higher than 70 F.

Diseases. -- Fish kills were reported in 22.7% of 246 ponds on 112 Illinois fee fishing areas (Lopinot, 1966). They resulted from transportation, disease, oxygen depletion and other causes. Low oxygen (winter and summer kills) were frequent. A pronounced increase in the incidence and severity of disease can be expected in fee fishing ponds compared with farm or ranch ponds because of the crowding and frequent injury. As density increases, the ease with which pathogenic organisms are disseminated is greatly enhanced. The operator of a fee fishing pond can expect to encounter an epizootic of some sort and he should be aware of the disastrous effects that an outbreak may have on the business. Frequent stockings may lead to introductions of disease organisms, especially when the fish are obtained from several sources. Wild fish may also be a potential source of disease organisms.

It is highly desirable to treat each new batch of fish before stocking. Few medications are available for specific fish diseases. In most instances, chemicals have been "borrowed" from application for domestic animals. Although producers use many drugs and chemicals in controlling external parasites, only salt, copper sulfate, and vinegar (acetic acid) have been cleared for use on food fish. The fee pond operator is in a very bad position because any requirements for "withdrawal" after treating for pond weeds or disease implies he must close down. Two or more ponds are absolutely essential to avoid closure when chemical applications require a withdrawal period for food fish.

Insurance

The general public assumes someone is responsible for damages in all phases of life and this is also true where recreational facilities are provided for the use of others.

The subject of negligence fills many law books, but it is usually defined as conduct that is blameworthy such as the failure to take reasonable precautions to prevent injury. It produces liability because it creates a greater risk of causing damage than what is legitimately imposed on another. The primary liability risk is drowning, but other types include accidents and broken dams.

LIABILITY IS IMPOSED ONLY IF THE CONDUCT IS NOT REASONABLE! Courts refer to the "reasonable man test," that is, what would a reasonable man do under the circumstances involved. It is the operator's responsibility (sometimes defined by statute) to maintain equipment so that their safety is insured. The law dictates that operators exercise at least ordinary care to see that premises are safe for public use. A failure to exercise such care constitutes negligence and carries with it an obligation to respond in compensatory damages.

Examples of Negligence:

1. No fence around pond to prevent children (non-patrons) from walking in and drowning; children younger than the age of reason are not able to recognize the water as a danger to which they are exposed.
2. Children permitted to play on fishing piers (patrons) where no rescue appliances or lifeguards were provided.
3. Falling from unprotected retaining wall; sharp bank; depression or obstructions in foot paths.

Examples of persons to whom liability is implied:

1. Invitees: persons invited on the premises; the invitation may be expressed or implied. In a business, the invitation is implied. A business that has been established and advertises or solicits the general public to use such premises has placed themselves in the position of the necessity for the exercise of reasonable care to protect the public from injuries.
2. Licensee: a person that enters the premises of another for his own interest or convenience. Such persons would be salesmen, government inspectors, meter readers.
3. Trespassers: the lowest standard of care is applied to persons on the premises without authorization. Implied permission (persistent trespass) assumes the invitation was implied. Also, children younger than the age of reason, are not able to recognize the danger to which they are exposed.

Liability insurance rates are levied for the variety and hazard of the activities related to a fee pond. There may be a general rate for fee fishing pond or lake and special rates for such extra facilities as:

1. fishing piers (earthen or wooden);
2. food sales--related to sale or distribution of deleterious food products, usually in food poisoning to the consumer;
3. use of boats (and motors);
4. playground equipment;
5. picnic tables.

The addition of facilities increases the liability hazard to the public. Rates apply first to vacant ground set aside for the enterprise and then add premium charges for additional hazards. Companies have attempted to delineate between major and minor hazards, such as different boats and motors of various sizes and horsepower.

Businessmen will not be surprised, but others may be shocked at the high cost of liability insurance. Actually because of the frequent failure to maintain premises or because recreational enterprises do not fall into standard classification, they are assessed high premiums. Typical coverages for 5/10/5 ($5,000 for each person, $10,000 for each accident and $5,000 for property damage) may range from $150-250.

Statutory Rules and Regulations Governing Operation of a Fee Fishing Pond*

Department of Conservation (Conservation Commission, Department of Game and Fish, Forestry Fish and Game, etc.).--In most states, fish and wildlife may be propagated, bought, sold, transported or imported only with authorization of the Conservation Commission. Control, management and regulation of fishery harvest in public waters is vested in the Conservation Commission. Regulations usually relating to operation of a fee fishing pond, deal with commercial propagation, transportation, and sale of fishes. Most states have regulations regarding importing fish, or transporting species designated as game fish. Kansas, since 1965, however, does not require a permit or license to import minnows or game fishes (Roy Schoonover, Fisheries Chief, personal communication). They have no tagging or inspection requirements.

State regulations regarding the production, sale and distribution of fishes are justified on the basis that they protect the public resources from dangers of introduction of undesirable, exotic fishes, or diseases and prevent the exploitation of the public fishery resource by mercenary interests. Permits or licenses are often clearly established for the benefit of both the producer and sportsman. The Missouri Department of Conservation (Wildlife Code of Missouri, 1970, Section 1.34) requires a fish importation permit (no fee) to prevent importation of dangerous salmonid diseases. Live salmonid eggs or fish must be certified free of infectious pancreatic necrosis (IPN), viral hemorrhagic septicemia, and whirling disease (*Myxosoma cerebralis*), or other diseases which may affect fish stocks within the state. Certification of imported stocks can only be done by competent fish pathologists.

Missouri has a special "Fee Fishing Area" permit ($20.00) which is specifically designed to cover the fee fishing situation. The Missouri Fee Fishing Area Permit includes the following restrictions:

a. all fish shall be legally purchased from a duly licensed source;
b. no fishing permit is required by the patrons to take or transport fish from a licensed fee fishing area.
c. the patron taking fish is required to possess a bill of sale showing (1) his name and address, (2) number and kind of fish taken; except these are not required by a holder of a sports fishing permit unless the patron exceeds the daily statewide possession limit, (3) date, (4) fee fishing area permit number;
d. operator must keep records of all fish purchases and sales.

In Oklahoma, a fee-fishing operator operates with the authority of an Aquatic Culture License ($5.00). The producer can import channel catfish, largemouth bass, bluegill, trout and other game species for stocking. The non-resident producers may transport these fish into Oklahoma without a special permit. On the other hand, minnows may not be imported without the Non-Resident Commercial Minnow Dealers License ($300.00).

Fee-fishing operators generally feel it undesirable if their patrons must also have a state fishing license. This is especially true of the non-resident tourist patrons. The requirement of a bill of sale is essential for the state to properly enforce fish and game regulations applicable to public waters.

Health Department

State, or City-County Health Departments. -- An operator must comply with local and state health laws. Periodic checks may be made on any recreation business catering to the public. Toilets, and other restroom facilities, and refreshment concessions operations must be kept safe and clean for public use. Public water systems require health department approval. The location of the sources of water and construction of the system have to meet the minimum requirements of state law. State health department must give approval to all proposed plans for public water systems and sewage and solid waste disposal facilities in recreation areas prior to their installation. Final approval must be given before it is put into operation. The public demands a safe water supply, adequate facilities for sewage and solid waste disposal.

Zoning. -- Operation of a put-and-take pond within the corporate limits of a town or municipality will be governed by local zoning regulations. Clearance must be obtained with appropriate local officials, the city commission, or others, prior to land purchase or construction. This should be done in the early planning stages.

*This section provides guidelines only. Regulations with the State, County and City were not assessed.

Department of Agriculture

There exists in every state an agency whose function is to protect the public from unsanitary food preparation. In Oklahoma, for example, the Meat Inspection Division of the Department of Agriculture inspects the processing of poultry, cattle, swine and sheep, but not fish! There are no Oklahoma statutes regarding fish inspection and existing agricultural agencies have no jurisdiction. In Oklahoma, the State, or City-County Health Department seem to be the only agency having jurisdiction over the processing of fish.

Scales used for legal trade must be of a design approved by the U.S. Department of Commerce, Bureau of Standards. Generally, scales must be inspected once each year. In Oklahoma, this is done by the Department of Agriculture, Marketing Division.

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Cage Culture of the Channel Catfish[1]

William M. Lewis and Mark Konikoff

Cage culture of channel catfish is still in the experimental stage. From information that has been made available, including an unpublished progress report from Southern Illinois University subsequently modified and published in The Catfish Farmer (Fall 1969, Vol. 1, No. 4); the work at Auburn University, Auburn, Alabama by Dr. H. R. Schmittou which he presented at the 1969 meeting of the Southern Division of the American Fisheries Society; and work done by Dr. Richard Collins, State College of Arkansas at Conway and published in The American Fish Farmer (Feb. 1970, Vol. 1, No. 3), we are justified in saying that the method shows considerable promise of being commercially significant. We anticipate that results reported by some of the many persons who are trying the method will be available in the near future. At our own laboratory we have answered over 1000 requests for information and, assuming that a percentage of these persons will undertake this type of culture, we should be able to accumulate information rather rapidly. To date, we have had an opportunity to talk with two private concerns that have used the method, and they indicated satisfactory results. In addition to the use of the cage method for raising channel catfish, we have had correspondence from an interest in Canada that is investigating the use of cages for trout culture.

Mr. Roy Heidinger of our laboratory has investigated the use of cages in combination with ultraviolet light as a means of rearing bluegill. This work proved highly successful.

At this time we can add little in the way of hard data to what has already been published. It is possible, however, to review what is known and to make some additional comments concerning the problems involved and their solution.

The principle of the cage method:

When fish are cultured at a high density in a raceway, it is difficult to maintain desirable environmental conditions, and especially to avoid the accumulation of waste materials including carbon dioxide, ammonia, fecal material and uneaten food. In cages the rate of exchange, both by mechanical agitation and by diffusion, is such that the oxygen level, carbon dioxide, and ammonia within the cage is essentially identical to that in the surrounding water. Thus, as far as these environmental considerations are concerned, it is feasible to confine fish in cages at high density with little or no problem with environmental conditions associated with crowding.

Advantages of the cage method:

Many of the advantages of the cage method are obvious and attention has been called to most if not all of them. The method lends itself to greater mechanization in fish farming, permits increased environmental control, and allows the use of waters that would not otherwise be usable for commercial fish farming. The method is adaptable for use in the culture of fish that normally overpopulate so seriously as to make the production of edible size fish impractical. In addition, the cage method makes it possible to control density throughout the growing season.

Where existing lakes or even rivers can be used, the cage method eliminates the cost of pond construction. It can thus greatly reduce capital investment and give greater flexibility in terms of expansion or reduction of the size of operation at a given location.

Disadvantages of the cage method:

Fish confined in a cage succumb to asphyxiation more readily than fish which are free in a pond. Thus when dissolved oxygen drops to approximately one ppm, mortality may occur among caged fish while those free in the pond survive. The difference in sensitivity of the caged and uncaged fish is probably related to the inability of the

1/This work was done under Bureau of Commercial Fisheries Projects 4-32-R and 4-51-R in cooperation with the Illinois Department of Conservation.

caged fish to seek areas where some oxygen remains, or cooler areas where their oxygen demand may be less. However, under reasonably good conditions and management, dissolved oxygen would not be expected to drop as low as one ppm, therefore we cannot consider the slight difference in sensitivity of the caged and uncaged fish to be a serious weakness of the cage method.

A second potential problem in cage culture is behavioral. In our earlier work we stocked fish at densities from 50 to 300 per cubic yard. Fish stocked at the lower densities showed pronounced evidence of fighting after they reached a size of approximately one-half pound. We concluded that the channel catfish should not be stocked at densities below 150 fish per cubic yard, and it appears that considerably higher densities are satisfactory. However, even at densities of 150 - 200 fish per cubic yard there is still evidence of interaction between the fish which might be interpreted as a hierarchy. Thus when we compared growth in cages of different depths, but maintained at the same density, the fish in cages with five feet of water depth exhibited more pronounced differential growth than did similar fish stocked in cages with three and one-half and two feet of water depth (Table 1). There was evidence of some fighting in cages having two feet of depth even when stocked at high density. We interpret this to indicate that both fighting and differential growth are a function of hierarchy. In the deeper cages hierarchy functioned to prevent the subdominant fish from feeding and there was a corresponding reduction in growth, while in the more shallow cages all fish fed but there was a continual attempt to establish a functional hierarchy.

Table 1. Effects of cage depth on variation in growth, fighting, and food conversion (September 1969 harvest).1/

Cage			Stocked2/		Harvested	Mor-		Coeff.	Food
	No. & Vol.		No.	Avg. wt.	Avg wt.	tality	In-	var. for	con-
depth	(ft)	(m^3)		(g)	(g)	(%)	jured3/	wt. (%)	version
D-1	2.0	0.71	107	105	495	3.7	32	22	2.37
D-2	2.0	0.71	107	145	620	19.6	6	21	2.87
D-3	2.0	0.71	107	277	1076	0.9	1	14	1.67
								$\bar{x}$ = 19	
D-4	3.5	1.25	187	70	383	2.1	0	49	1.46
D-5	3.5	1.25	187	168	673	0.5	0	27	1.46
D-6	3.5	1.25	195	294	1022	2.6	0	19	1.52
								$\bar{x}$ = 31	
D-10	5.0	1.78	267	80	470	0.0	0	48	1.61
D-11	5.0	1.78	267	179	694	1.9	0	24	1.52
D-12	5.0	1.78	267	184	562	2.2	0	37	1.58
								$\bar{x}$ = 36	

1/Fed 4/14 to 8/25. All fed 100 times in 133 days except D-12 which was stocked two weeks later and fed 85 days.
2/All cages stocked at a rate of 150 fish per m^3.
3/Fighting injuries evident at harvest.

Cage design:

After having tested a variety of shapes and sizes of cages, we feel that the cage shown in Figure 1 incorporates a maximum number of advantages, at least for a home manufactured unit. The cage is 3 feet wide, 4 feet deep, 6 feet long, constructed of 1/2" x 1" welded mesh, 16-gauge galvanized wire, pre-dipped in Texaco Netcoat. The cage is on a 2" x 2" wooden frame with styrofoam floats at each end. At the waterline there is an aluminum screen which prevents loss of food from the cage. The cage is equipped with a cover. This size cage is easily handled, and due to the design is relatively cheap to construct. We originally used electrical conduit for the cage frame, but we have found that since the wire can be stapled to the frame rather than lacing it in place, a cage with a wooden frame is much easier to construct. The importance of dipping the wire prior to fabrication of the cages might vary with circumstances. Under some conditions there could be low grade zinc toxicity from the galvanized coating. Dipping should, of course, also extend the life of the wire. We have cages that have been in use for three years and show no sign of deterioration.

Bodies of water suitable for cage culture:

Even though caged catfish will survive in farm ponds and in small, shallow hatchery ponds, the danger of loss due to oxygen depletion is great, and on a commercial scale there is little to be gained from using small ponds that can be seined or drained. Cages will likely prove to be more practical when used in large lakes and in deep streams. Even in large lakes one must recognize that there is some enrichment of the lake associated with feeding a high

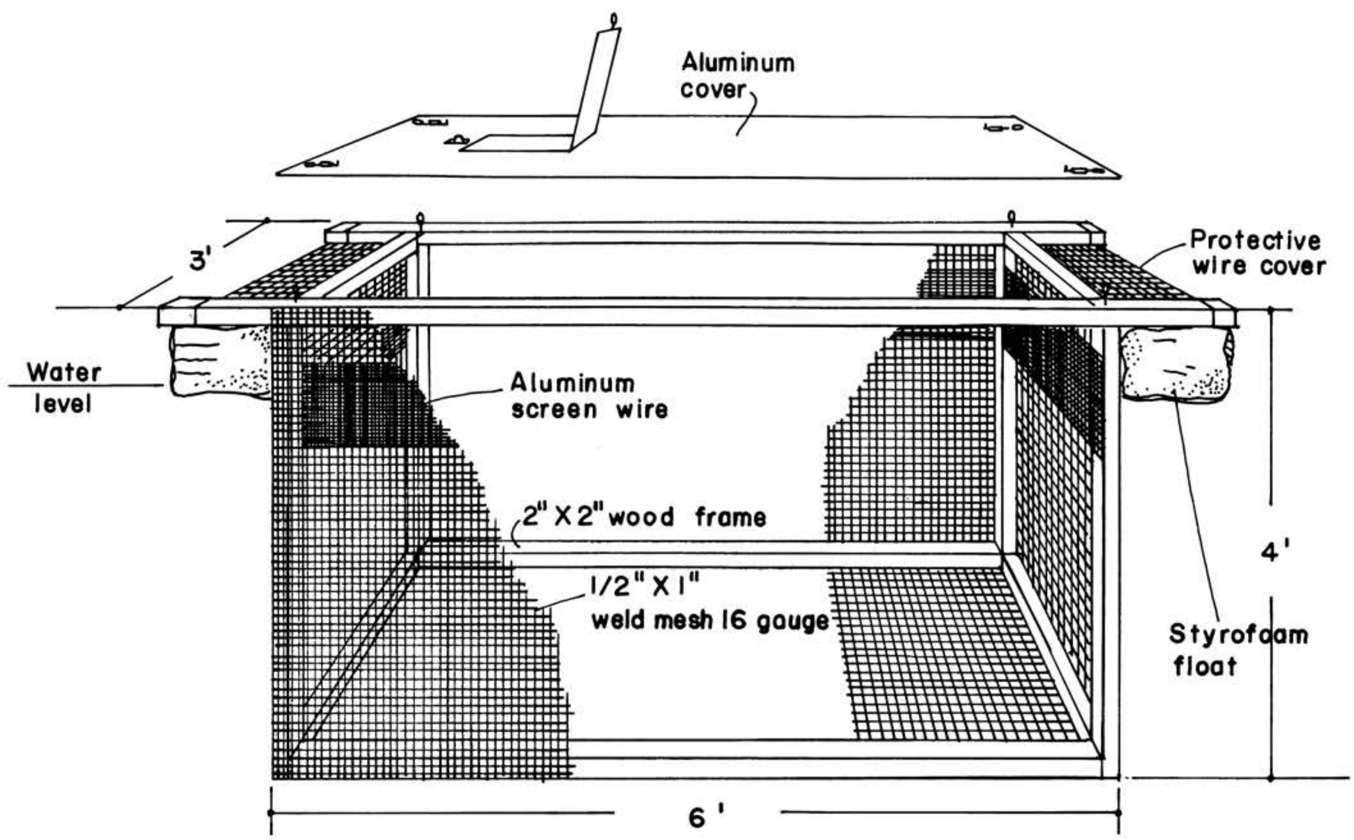

Figure 1. Cage design recommended for use in the culture of channel catfish.

poundage of fish. After three or four years a lake may exhibit considerable enrichment. As is the case in open pond culture, an inflow of fresh water is normally a benefit and will permit greater production per acre. It is worthy of note that the caging of fish does not change the bio-chemical carrying capacity of a body of water. Thus one would not expect to produce more than 1500 to 2000 pounds of fish per acre unless there was a significant inflow of fresh water.

Location of cages:

The cages do, of course, float independent of the bottom, but we have found no indication that any great depth below the cage is necessary and, in many cases, the bottom of the cage has been located within six inches of the pond bottom. It is perhaps more important to be sure that cages are in open water and are not located in a cove where the water is more stagnant and more subject to low oxygen. If sport fishing is practiced in the lake, the cages should be located in a restricted area away from constant disturbance and should be inaccessible to fishermen. In recent work we have used a floating pier in preference to using a boat for feeding. Indications are that cages do not have to be widely dispersed over a body of water. We are now placing our cages immediately adjacent to each other in a series on each side of a floating pier.

When choosing a location for cages in a lake, it is desirable to place the cages in proximity to any inflowing water so that emergency aeration may be provided during critical periods. It is also desirable to place cages where electricity is available so that mechanical aeration can be used during an emergency period and so that mechanical feeders can be installed.

Size of fish and density of stocking:

We have attempted stocking one-inch fingerlings in cages of small mesh wire with the idea of subsequently transferring them to larger mesh cages. The results of this investigation are not conclusive. Survival was rather poor but mortality was attributed to an infection of Trichodina on one occasion and to an infection of Ichthyophthirius on another. Both of these problems might be avoided.

On the basis of our present information, we suggest that the minimum practical size fish to stock in cages is approximately five inches. Of course, fish of this size may not reach marketable size by the end of the first year, but since they can be carried over winter in the cages, and since a larger fish is quite marketable, we can see no great difficulty in a two-year rather than a one-year program. The management program must be adjusted to local conditions. In many situations it would be desirable to hatch fingerlings, hold them for approximately two weeks in nursery tanks, transfer them to raceway type tanks and, when the fish reach five inches transfer them to cages, perhaps at a higher than normal density with a view to reducing the density at the end of the first year in cages. If the fish are to be hatched and stocked out in ponds, we suggest a stocking rate of 30,000 per acre, anticipating a harvest of approximately 20,000 per acre of six to eight inch fish that would be stocked in cages the following spring. In any event, the management program should be such that the fish are always handled during cool weather.

Feeding:

Natural food is not available to caged fish. The absence of this qualitatively important supplement suggests that a food that might be adequate for open pond culture might not necessarily be satisfactory for cage culture. Trout foods are formulated as complete foods, since in trout culture the fish have little or no natural food to supplement their diet. With this in mind, we have used Purina Trout Chow exclusively with the exception of a limited amount of experimental feeding. It is quite probable that a food less expensive than trout chow may be formulated or may already exist, but it will be necessary to re-evaluate foods for use in cage culture. It is also possible that a floating catfish food might be fed four or five days per week and the more expensive trout food one or two days.

While to date we have used floating food exclusively, we have limited evidence that it may be desirable to use a sinking food when the water temperature is below 65°F. It appears that at water temperatures between approximately 50°F and 65°F the fish might utilize the sinking but not the floating food. We plan to investigate the use of a sinking food fed at a low rate once each week. This, of course, necessitates the use of a pan or tray in the cage to contain the food.

We have also been concerned about the importance of natural food to small fish. First, we are of the opinion that natural food is an important supplement to the ration fed to small fish and second, our data indicate that smaller fish require frequent feeding. It is recognized in open pond culture that small fish will feed three or four times a day, while adult fish will usually feed only once. It appears that small fish either do not have the stomach capacity to consume enough food for a 24 hour period, or that they process the food more rapidly due to a higher digestive or assimilation rate. In any case it appears desirable that fish smaller than one-fourth to one-half pound be fed more than once a day. When fish are feeding properly, they will respond to the food immediately and consume it within a few minutes. We have taken advantage of this in adjusting our feeding rate. The quantity of food is continually adjusted to the amount the fish will consume in five to ten minutes. We find that the larger fish feed best at twilight and we attempt to feed them regularly at this time.

Diseases and parasites:

Caged fish to not seem to be more susceptible to diseases and parasites than are fish produced in open pond culture. It is true, however, that if cages are used in rivers or in large lakes with a native fish population, the caged fish would probably be subjected to a constant source of infection by most of the common parasites. The seasonal occurrence of the parasites, however, is favorable to the development of a management program that would aid in avoiding the infection of catfish. Thus *Ichthyophthirius* is prevalent only when the temperature is below 60°F. *Dactylogyrus* is usually troublesome in late fall and winter. *Trichodina* is less troublesome on larger fish and, in our experience, columnaris is usually associated with damage from other parasites. While it would appear that the occurrence of parasites and diseases might make it impractical to use large lakes and rivers, such may not be the case. Confinement of the fish independent of the bottom may reduce transmission of certain parasites. Thus we predict that infection by Henneguya and other myxosporidians will be reduced as a result of caging.

Conclusions:

After having worked with the cage method of culture for three growing seasons, we are convinced that it is basically a sound method of rearing catfish from yearlings to marketable size. It appears that it will be applicable to commercial production. We must recognize, however, that there are many questions yet to be answered. We still do not know the optimum cage design. Our data at present indicate that cage depth is an important consideration. We have not demonstrated what optimum density is. Our prediction is that we will eventually use a high density for small fish and subsequently reduce the density. To date we have talked of density only in terms of numbers of fish per cubic yard. It is obvious that we will eventually have to consider density in terms of weight per unit volume. All of the principal foods now available need to be evaluated for cage culture and the food manufacturers need to investigate adjustments in formulation that may be required. The use of a sinking food in cages and a combination of sinking and floating foods needs to be studied. These are only a few of the variables that require investigation as we attempt the expansion of this method. We are sure that by this time next year we will have additional information.

Catfish Marketing - 1970

John E. Greenfield

The marketing function in the catfish industry at this time is particularly significant and deserves special attention. Catfish are produced almost entirely by crop farmers who also own many of the processing facilities. Accustomed to dealing with commodities for which organized, national markets exist, farmer-owned businesses have little experience to draw upon in regard to marketing a specialized product for which there is no national, or even regional, market to perform the pricing and distributive functions. Moreover, marketing continues to suffer generally from the "huckster" image. Unlike production or processing, the marketing function does nothing to the physical state of the product and the legitimacy of value added through marketing effort is not really appreciated and is often viewed as a necessary inconvenience. Companies with this view of the marketing function are unlikely to engage in the heavy investment in marketing research and development that is characteristic of successful consumer food product companies.

Last, but of equal importance, is the misunderstanding of the nature of the marketing function. Marketing in its broader sense requires much more than selling, per se. At this stage of the industry's growth, planning, market research, advertising, public relations, inventory control, scheduling, and the establishment of marketing controls, are every bit as important as selling itself.

At least in this author's view, marketing looms as the major barrier to continued, orderly growth in the catfish industry. The ability to grow and process catfish has been demonstrated beyond any doubt and major improvements in both technologies are already in progress. Marketing problems are occurring with increasing frequency, however, as evidenced by symptoms such as: increasing inventories, inability to produce the products the market requires, a large price differential over wild catfish products, and failure to achieve quality consistency.

The first step in overcoming the marketing hurdle is an understanding of the current situation. This discussion seeks to summarize what we think we know about both demand and supply factors affecting marketing. The limits in which the marketing problem can be managed, probably depend upon the ability of the firms in the industry to act cohesively and with considerable discipline in their attack on product standards and grades, market research, and market development.

Some observations on the nature of the demand for fish in general seem relevant. With the exception of certain low priced, bland tasting fish such as codfish block products and widely accepted shellfish such as shrimp, there is no uniform national demand for most fish products. Because fish have never been produced in controlled culture systems, most people have been exposed only to species that occur in the wild state in the vicinity of their home. High preference is associated with simple familiarity. Catfish may be considered a premium species in a river community where they were traditionally available, but despised by another community where traditionally they had been considered a scavenger species. This problem is not peculiar to catfish but explains the localized nature of demand for specific species everywhere. Instead of a true national or regional market for catfish we are confronted with a collection of small, isolated pockets of demand, each expressing its own degree of preference and resulting in different levels of elasticity of demand. Even when catfish are given high preference by a series of local markets, there will be traditional differences and preference for product forms, size of fish, and methods of preparation.

The lowest level at which fish products are differentiated in the market occurs with regard to species. Within a given species it has been extremely difficult for individual producers or processors to establish strong brand franchises. The difficulty of differentiating among brands of fish products lies not so much in the product itself as in the generally low level of per capita fish consumption in the U.S. Relative to products that are consumed frequently, in high volume, and in every home, the establishment of a specific brand franchise simply is not worth the cost and effort of building it.

Another problem is that catfish, as a species, is not preferred in the same regions that have a tradition of high per capita fish consumption. Catfish is native to and preferred by consumers in the South Central and Southeastern States. The highest levels of fish consumption generally are found in the New England and Middle Atlantic States.

The isolated and fragmented nature of the demand for catfish is extremely significant to the marketing function. It implies that a large number of products will have to be distributed to many, relatively small markets, thus (1) increasing the cost of physical distribution, or (2) requiring a substantial investment in market development and selling expense in order to make the many, small, diverse markets more homogeneous. The fragmented nature of demand also explains why there are no established channels through which catfish can be distributed, except at the local level. The marketing task for the catfish industry must include the establishment of the distribution system itself.

The Bureau of Commercial Fisheries recently conducted two significant market research projects. The first involved a survey of conventional, family oriented restaurants located primarily in the South and Midwest. This study was conducted by the Market Research Corporation of America in 1969 and embraced approximately 780 restaurants in the sample. This study confirmed that catfish consumption was highest in areas where fish consumption is generally low. It also indicated that there is no significant seasonal, age or racial patterns to catfish consumption in restaurants. The restaurants included in this study purchased catfish from either traditional fish wholesalers in their communities or from traditional restaurant wholesalers. Although frozen catfish are used universally, the fresh form was very much preferred. The association between freshness and quality is a well established consumer bias in both poultry and fish. In both of these product areas consumers indicated a willingness to pay a premium for the fresh product only to freeze it at home for future use. The whole, skinned product was clearly the preferred product form by this class of restaurants. Although catfish was served to some extent by about 13% of the restaurants included in the sample, it was seldom featured or promoted.

The experience of restaurant managers with catfish was surprisingly identical in both the South and Midwest (Table 1). In both areas 55 to 59% of the restaurant managers interviewed were aware of the availability of catfish but had made decisions not to include it on their menu for a variety of reasons. The major reason for excluding catfish was that it would not be ordered frequently enough to meet minimum restaurant turnover requirements. Total unawareness of the availability of catfish was significantly higher in the Midwest than in the South.

Restaurant managers unaware of the availability of catfish in the South (26%) and in the Midwest (34%), represent an opportunity for further penetration of the conventional restaurant market. These managers have yet to make a conscious decision to include or exclude catfish. Actual usage was higher in the South (15%) than in the Midwest (11%). Most all restaurant managers believed that the catfish they served came from wild sources and were almost totally unaware of the existence of farm raised catfish or its availability in their area. Catfish was always served in the breaded or battered deep-fried form.

Table 1. Restaurant Managers' Experience with Catfish

	SOUTH	MIDWEST
Aware, But Non-Buyers	59%	55%
Unaware	26	34
Buyers	15	11
Total	100%	100%

In addition to the MRCA restaurant study, prior experience would indicate that wholesalers believe that price resistance occurs with catfish among restaurant customers in the range of 75¢ per pound and above. At today's price structure (Table 2) pond-raised catfish would be well above this price range.

A brief digression on the role of catfish in recent developments in the fast-food restaurant industry seems appropriate. Early in 1969 a great deal of interest developed in using catfish as another vehicle on which to base a fast-food restaurant business. This development occurred in a period when the investing public was becoming increasingly disenchanted with both fast-food restaurants and franchising as high-growth business concepts worthy of high stock price multiples. This is, of course, a personal judgment. The majority of entrepreneurs attempting to build a fast-food restaurant business around catfish were neither experienced restaurateurs or franchisers. They attempted to enter the franchising field prematurely, without building a base of successful operations and the service capability necessary to make a marketable package to potential franchises. As premature franchising efforts failed to live up to expectations, many entrepreneurs also discovered that they were unable to build profitable pilot restaurants. The fish supply industry had not developed to the point where products could be delivered on specification to accommodate restaurant portion control, with the result that high food costs plagued the pilot demonstration restaurant units. Lack of restaurant experience further complicated the problem in that many pilot restaurants were poorly located for traffic generation and high turnover. Most pilot restaurant concepts were oriented to the family market. Since fish is not universally accepted and preferred it was necessary to include other menu items in order to accommodate the tastes of complete families. This is particularly true when a restaurant features a single species of fish, with even more limited appeal. Some existing restaurants adopted catfish as a supplementary menu item. Others catered much more heavily to carry-out trade, where the requirements of satisfying an entire family's taste from one facility is less important. At present, it appears that 3 or 4 reasonably successful restaurant operations have found a way to use catfish as a lead or featured item. Perhaps 15 or more restaurant businesses were actively investigating sources of supply a year ago and many inexperienced processors came to think of them all as certain markets.

Table 2. Catfish Prices
(10-14 oz., I.Q.F.)

F.O.B. Processor or Importer	Price Range 1/	
Pond-Raised	$ .82	$ .99
Wild, Southeastern	.60	.65
Wild, Imported	.50	.60
Wholesale to Individual Restaurants or Retail Stores		
Pond-Raised	$ .82	$ .99
Wild, Southeastern	.71	.75
Wild, Imported	.60	.65
Retail to Consumers		
Pond-Raised	$1.19	$1.39
Wild, Southeastern	.99	1.09
Wild, Imported	.89	.99

1/ The prices are meant to reflect only the approximate range of price movements, over the course of a year, for various volumes of unit purchases. At any one time, depending upon availability, the price relationship among the 3 product groups can be quite different.

The second study, conducted by Market Facts Incorporated of catfish consumption in the home included approximately 1500 housewives who kept daily diaries of food purchases. Eventually, data will be available for an entire calendar year but 6 month preliminary data yield some interesting insights. Of perhaps greatest significance was the inverse correlation between catfish consumption and income at very low levels (Table 3). The per capita consumption of catfish in the lowest group, representing incomes of less than $1000 per year, was almost twice as high as households with incomes of more than $3000 per year. This would suggest that other environmental and cultural variables are also correlated with catfish consumption. Catfish certainly can not be considered an inexpensive fish product and its heavy consumption in the $.80 to $1.40 per pound retail price range is indicative of very, very strong preference among low income consumers.

Table 3. The Effect of Income on Catfish Consumption in the Home
(February - July 1969)

	Consumption Per Capita	
Annual Cash Income	6 Months	Annually
$ 0 - $ 999	.27 lb	.54 lb
1,000 - 1,999	.20	.40
2,000 - 2,999	.20	.40
3,000 +	.11	.22

The most obvious cultural factor associated with high catfish consumption among low income groups is apparent in an analysis of differences in consumption among racial groups (Table 4).

Table 4. Racial Variation in Catfish Consumption in the Home
(February - July, 1969)

Race	Consumption Per Capita 6 Months	Annually
Negro	.54 lb	1.08 lb
Caucasian	.10	.20
Other	.00	.00

Although Negroes as a group consume about twice as much fish per capita as Caucasians, they consume five times more catfish. This would suggest that catfish are much more highly preferred among Negroes, probably because of historic cultural associations in the rural South where fish were easily available to poor rural families. Large geographic differences in catfish consumption are also apparent and tend to verify the racial-income affects (Table 5).

Table 5. Regional Variation in Catfish Consumption in the Home
(February - July, 1969)

U. S. Census Region	Consumption Per Capita 6 Months	Annually
East South Central	.85 lb	1.70 lb
West South Central	.43	.86
West North Central	.10	.20
East North Central	.07	.14
South Atlantic	.05	.10
Pacific	.01	.02
Mountain	.01	.02
Middle Atlantic	.00	.00
New England	.00	.00

Catfish consumption was almost undetectable among sample segments in the Pacific, Mountain, Middle Atlantic and New England States. High consumption was recorded in both the East South Central and West South Central regions, with consumption in the East South Central States almost double that of the West South Central States.

These cultural-income-geographic market characteristics suggest some very attractive marketing opportunities to the catfish production and processing industry. At present, very little marketing effort is focused on Negro, low-income markets, except as it is coincidental with local marketing efforts in the catfish production region. Whenever a market has an identifiable segment exhibiting very high consumption characteristics, it should behoove the marketing function to seek communication and distribution methods that will reach the target segment efficiently. If a marketing strategy can be developed that will be effective with the target market segment, with little overlap or carry-over to other segments, selling costs per unit of goods sold can be minimized and an attractive substantial profit picture usually ensues.

Several significant supply factors must also be considered in any discussion of the marketing situation because they act as parameters or constraints on marketers' ability to plan and act. Although the major source of catfish is the harvest of wild fish from public waters, this source of supply is diminishing rapidly due to pollution and conflicts with sport fishing. Prices for wild fish are increasing constantly.

The current stage of development in the pond-raised catfish industry results in both high production and processing costs. The fact that pond-raised catfish sell at a substantial premium over wild catfish severely limits pond-raised catfish in terms of market penetration. As wild catfish prices increase and pond-raised catfish production and processing costs decrease, the pond-raised products should begin to compete in more markets with less and less need to rely on the promotion of quality differences.

The outlook for achieving a substantial reduction in production costs is very bright (Table 6). Both raceway culture systems, to the extent that they have been developed, and foreign production, with either conventional open ponds or raceways, hold promise of achieving costs in the range of 20¢ per pound or less. These cost estimates are calculated on the same basis as the 31¢ per pound figure achieved by today's production industry with open ponds in the Mississippi Delta. The term raceway may have many different connotations. It is used in this sense to describe any system whereby a large number of fish are cultivated in highly manageable, high density systems. These systems involve very high water volumes, at favorable temperatures, and require very low water and pumping costs. Natural springs and effluents from power generating plants would be likely candidates for simultaneously achieving these conditions. Since raceways are more compact and manageable, they offer the advantage of shifting from a batch process, where the size of fish will always be variable, to a continuous process, where fish are harvested when each individual achieves the most desirable size.

Table 6. Current Production Cost Ranges of Alternative Culture Systems

	Cost of Production ($ Per lb.)	
Cultural System	Without Cost of Working Capital	Including Cost of Working Capital
Open Ponds, Domestic	.27 1/	.29
Domestic	.31 2/	.33
Foreign	.19 3/	.21
Cages	.27 4/	.30
Raceways	.20 5/	.22

1/ R. A. Grizzell, Jr., Pond Construction and Economic Considerations in Catfish Farming
2/ J. E. Greenfield, Economic and Business Dimensions of the Catfish Farming Industry
3/ Estimate
4/ W. M. Lewis, Feeding-Out Catfish In Cages
5/ Confidential Source

The general fish supply situation seems certain to benefit the catfish industry. The supply of competing, high-value ocean and fresh water species seems certain to become smaller, with the result that competitive fish prices will increase.

There are probably many markets in existence today that could find a place for catfish if supply problems were overcome. Large restaurant chains, for example, would require continuous quantities of uniform high-quality products, designed to specification, that the industry is not yet capable of delivering.

The organization of the industry itself is a problem. Small, farmer-owned companies simply have not yet developed the volume required, with the variable sized fish it must work with, to produce enough of any one product form, size, and grade to begin to tap this market. It is also difficult for small firms to engage in expensive market research, market development, and product branding activity. Product brand development is further discouraged by the difficulty of differentiating a product that has been traditionally considered a commodity.

The foreign supply picture, in the opinion of this author, represents the most serious threat to the existing and developing domestic catfish industry. Substantial stocks of wild fish exist in several foreign waters and are already being harvested for export to the United States. These exports are increasing rapidly and show substantial improvement in product quality in recent months. Rumored dissatisfaction with the quality of imported products is becoming a less frequent complaint at the wholesale level. As already suggested, foreign production of pond-cultured catfish probably will also offer real competition in the future. Technical problems, such as unexpected disease or parasitism, may develop to render raceways or foreign production locations impractical. At the time of this writing, there is no evidence to suggest that these kinds of problems will develop, however.

The catfish industry, as it exists at present, has the option of organizing itself toward a successful competitive strategy. It is always difficult to bring small companies together for cohesive action and the difficulty of this task should not be minimized. The benefit of cohesive action however, is immense. If the existing processors could somehow form a joint marketing venture, engage in strict adherence to product standards, and form a business entity large enough to engage in market research and development work, it is likely that they could exploit existing markets to which they do not now have access. Such a company, or cooperative, must be much more than the typical trade association. It must have the ability to generate substantial funds for marketing activity and must have real enforcement capability toward its own member producers. Although current efforts by Catfish Farmers of America to engage in public relations activity, adopt quality standards, and promote a logo representing assurance of compliance are admirable and genuinely useful, an association would be hard pressed to function as an operating, marketing company. As with most opportunities, the time during which the industry can organize to exploit it is not infinite. Immediate and vigorous action is recommended in order that a solid market position might be established for domestic catfish products in existing, high-value markets, to which it does not now have access. The firm that is first to deliver quality, consistency, and products upon specification will have a major advantage that will be both difficult and expensive to displace. Today's processing companies must initiate such an action if it is to transpire. Marketing strategy decisions, by commission or omission, over the next few months will set the tone and character of this industry for years to come. Although this stage in the development of an industry is not unique, it represents a singular opportunity to the catfish industry that may soon pass forever from view.

Marketing Panel

Lowell Mohler, Chairman

John Sullivan

James Ayers

Pete Reese

Gary Loff

LOWELL MOHLER

We have brought together a good selection of talent from several different areas in marketing. We have someone involved in retail marketing, one from the institutional area, one involved with wholesale, and one in processing. In addition, we have our research men who are full-time in this area of marketing.

The first panelist is Mr. John Sullivan of Mid-Central Fish and Frozen Foods, Inc., Kansas City. He has worked in many positions with Mid-Central and presently is their Corporate Treasurer. He has been active in the National Fisheries Institute holding various positions including Vice President, and is currently Chairman of the NFI's Promotion Division.

Next is Mr. Jim Ayers of the Bureau of Commercial Fisheries, Little Rock, Arkansas. His principal duty is providing technical assistance in the field of fishery marketing and education to fish producers, processors, distributors and merchandisors.

Mr. Pete Reese is from Topeka, Kansas. He is Director of Meat Procurement for Fleming Company.

Our final panelist is Gary Loff, Plant Manager of the Southern Catfish Processors of Dumas, Arkansas. As Manager of the Southern Catfish Processors, Mr. Loff supervises all purchasing, production, and marketing functions of the plant. Southern Processors is a fish farmers cooperative which processed over a million pounds of catfish in 1969. Incidentally, that is 38% of the U.S. total. Mr. Loff currently serves as Chairman of the Processors Committee of Catfish Farmers of America.

I am going to call on John Sullivan first to give us a little information about his company and tell us about his area of work.

JOHN SULLIVAN

Thank you, Lowell. I am with Mid-Central Fish and Frozen Foods with headquarters in Kansas City, Mo. We are now a full frozen food line distributor, carrying a total of 973 items.

We cover the central portion of the United States; a seven state area. Branch operations are located in Springfield, Missouri, Oklahoma City, Wichita and Amarillo, Texas. We are a wholesale company selling to wholesalers and retailers. Perhaps I should be a little more clear, instead of the term wholesalers I should use institutions. We sell to nursing homes, hospitals, schools, etc. Approximately 60% of our total volume is in the fish and seafood line and 40% in what we term frozen food or products other than fish and seafood. The institutional business amounts to 92% of our total volume with about 8% retail. So we are really not a large factor in the retail market, as such.

We think that catfish farming is one of the greatest innovations to come along in many years to help the fish industry.

LOWELL MOHLER

Thank you, John. And now we move on to Jim Ayers who will tell us a little about his area of work.

JIM AYERS

We were established to assist and work with the fish farmer. We have by no means all the answers, but by working with you we may come up with some kind of beneficial agreement.

Ours is primarily the marketing end, finding outlets for the products. Thus far I think you can sum up by saying that there is an excellent demand for fingerlings. We have not yet experienced too much of a problem in finding an outlet for them. In the Little Rock area some of the fingerling producers are thinking of upping the price because there was such a demand for them.

LOWELL MOHLER

Thank you very much. We'll get on with the program with Mr. Reese.

PETE REESE

We are a wholesaler that furnishes a complete line of groceries, meats, frozen foods, dairy products, and other services to independent retail operations. We service some 1900 independent retail outlets. I don't want to divulge any of the things that I discovered when I was asked to participate and began my investigation of catfish through these 1900 stores, so I'll turn it back to you.

LOWELL MOHLER

Thank you, Pete. Now let's hear from Gary Loff.

GARY LOFF

Southern Catfish Processors is a fish farmers cooperative. Last year we started operations the first of January with 13 members in two states, Mississippi and Arkansas. Presently, we have over 52 fish farmers representing a total of over 5,000 acres of catfish, of which 3,000 of these acres are committed to our processing plant.

We set out to stabilize the market, the price to the producer. We feel like we have done this. When we started up operations we paid 35¢ a pound. During the summer we increased to 40¢, and went down to 38¢ in the fall. We are at 36¢ a pound now. If we continue to get volume there will be no need for us to go any lower.

Our plant and building has a freezing capacity of 10,000 pounds per day of packaged, individual quick-frozen catfish. Last year we processed over a million pounds.

We are selling just about every level we can go. Last year we sold 90% institutional. However, we have sold direct, and indirect through brokers and distributors. We do have a franchise contract and do sell to specialty houses. So, after a year, we now sell to just about everybody. Orderly distribution is very important.

LOWELL MOHLER

Mr. Loff, thank you very much. Now that we have given each member of the panel a chance to talk about their own operations, we can get down to the questions.

Let's start off with a basic question of marketing food fish, and that is "What volume does catfish represent in your operation?" Where do you feel the market is going? Where is the action as far as catfish marketing is concerned in the future? We will start with John.

JOHN SULLIVAN

Lowell, catfish in our marketing operation is probably about sixth in volume of seafood sales. This is due mainly to product problems; supply principally.

Last year, for instance, we took on a farm raised catfish which we felt would really be a good one. Something our customers could depend on. Within eight months we sold 61,000 pounds. But, in addition to this we sold about 85,000 pounds of the wild, which incidentally was a 30% increase over the previous year. So cultured fish was all plus sales as far as we were concerned. Possibly it replaced part of the wild in some locations but certainly doing nothing to affect or deter the sales of the wild; if anything it helped it. As far as the market is concerned for the future, we feel that the entire field of catfish is wide open. The demand is out there. The restaurant operators, even the other institutional operators, particularly here in the midwest area are ripe - they are ready for catfish. We have to get them in some other forms than they are used to, however. But the big market, of course, will be in the present form. We find the trend in retail continues to be off as it has been the last couple of years since the Pope changed his mind on non-meat Friday. However, seafood sales outside of the grocery stores continue to rise rapidly.

LOWELL MOHLER

O.K. Jim, although you are not associated with the retail and wholesale operators, would you like to comment on this?

JIM AYERS

I think from a working standpoint we could say that 95% of our work is with the catfish people. However, other types of fish will not be marketed differently. First, a couple of comments about volume of catfish. During 1969 we found in processing plants where 80% of the production is located, (in Mississippi, Arkansas and Louisiana) that only 1.9 million pounds actually came through as finished product. This represents 3.1 million pounds of live weight going in or about 15 or 20 percent of maximum potential production. I believe eventually this will increase. Comparing January to January in these same 5 plants, there was over 101,000 pounds of processed fish produced in January, 1969. By January, 1970, two plants had folded but the three remaining plants produced 220,000 pounds (double the amount of production). I think we will continue to see this. In the overall nationwide survey we had 1/2 million pounds produced in 14 or 15 processing plants. We define a processing plant as having a maximum capacity of 2,000 pounds of finished product per day.

LOWELL MOHLER

Over to you, Pete. What volume does catfish represent in these 1900 supermarkets you work with?

PETE REESE

In preparing for this conference I sent out a survey which I will get into later with a number of questions I want to ask. The first question I asked was, "Are you presently handling fresh frozen catfish at warehouse level?"

I was flabbergasted to discover that not one of our divisions handled fresh frozen catfish at the wholesale level. And, in making a survey of the stores of which Mid-Central spoke about - a moment ago - on store door delivery, only a very, very small dollar volume of fish was reported through these various stores.

The second part of the question that Lowell asked was, "Can this volume be increased?" My answer is "Yes." When you are doing absolutely nothing and start doing twice that, you've got to be better. So I think there is a tremendous possibility and potential.

LOWELL MOHLER

Thank you, Pete. Gary, what's your opinion on where the market might be in the future?

GARY LOFF

I think the institutional market will probably be the mover in the next couple of years. We don't have the volume for the retail marketplace. Pete just said he had 1900 stores; I couldn't begin to supply 1900 stores. The reason I say the institutional market will take our fish is because of quality. The institutional markets are the ones that will pay a premium price for quality fish.

Where is the market? The market, I am convinced, is everywhere in the country. I've talked to people from Massachusetts to California. They know what catfish is. Some people don't like them, others do, but they do know what catfish is. We have half the problem licked in promotion there. We will be private labeling for a concern in Delaware this spring. This will be a first for catfish in the northeast, and basically that will go institutional. But the big problem in going this route is distribution. There is practically no way you can take 25 and 50 pounds of fish to each restaurant. Thus you must go through a distributor. This is where Mid-Central fits in; being a distributor.

LOWELL MOHLER

Our panel seems to think that a demand exists for catfish as a table food. Let's talk about price. What will growing fish mean in dollars? What will retail prices have to be to encourage retailer and wholesaler to handle the product? Let's start with John again. The question, "What type of pricing system will put catfish in a competitive place with other items you handle?"

JOHN SULLIVAN

With a good quality catfish (properly processed, nicely wrapped), I don't feel that pricing is the most serious factor. We are selling to the majority of our institutional customers for $1.15 to $1.25 a pound. The wild catfish sells for about 95¢ per pound, a difference of 20¢ to 30¢ a pound. But we found out, almost from the outset, that this really wasn't a factor if we took the time and effort to sell cultured catfish to the customers. Once we did this, the price was really secondary; he really didn't care because he knew he had a good product. It is important that the fish we deliver next week would taste the same, would look the same, and he could cook it the same. If it were two weeks from now, he could do the same thing. The chef in the kitchen would know what would happen to it. He knew exactly what the product was and how much he was going to pay for it. He knew they were in individual bags. He didn't have to thaw out 20 pound packages or a 25 pound package and maybe use five fish a day. So there are a lot of other advantages that enter into this other than just a price factor. But I do think the trade is going to have to be sold.

JIM AYERS

The work we are doing with catfish is geared more to the retail and institutional trade at the present time. We are in agreement with Gary. We agree there is more profit in the distribution of institutional type of products than in retail, and I agree with Gary that institutions in the next couple of years will take the bulk of the product.

We are trying to approach the retail trade. In five years we will have to if our production continues to increase as it has in the last couple of years. We have approximately 4,000 acres under water. With this volume in mind we are doing our work, primarily with the retail trade. The Bureau contracted a survey in 1969 with the National Marketing Research Corporation in 900 restaurants. They were questioned about catfish. "Do you use catfish?" "What do you think about them?" Some startling answers were found. Only 14% of the 900 restaurants acknowledged using catfish or had it on their menu. This means that out of 900 restaurants possible, 126 respondents were using catfish. This survey was carried out in the southern states, several midwestern states and California and Oregon. Of the 14% using catfish only 3% advertised catfish. Therefore, of the 900 restaurants in the survey, 4 advertised catfish.

I predict that before we see success in the retail trade we will have to see a price of about $1.00 per pound. We conducted a survey in the Little Rock area with some in-store testing in several supermarket chains. By the time the consumer got the product it was costing them $1.39 per pound. One of these supermarkets entered catfish as a food item during November and December, which are bad months to begin with. This supermarket sold less than 100 pounds of catfish steaks, which was from pond raised catfish. They felt sales were so poor they asked the supplier to remove the fish. The reasons, I feel, were that this was a holiday season and the stores were in the catfish belt where fresh catfish could be purchased for 90¢ per pound. These are some of the things we ran into. We are currently making a regional survey on institutional trade looking at Kansas City as a potential area; also Dallas, Fort Worth, Memphis and maybe St. Louis to get feedback as to what pricing may be.

PETE REESE

First let me throw out some questions that you can consider too. No. 1 if we go retail, what segment of the population are you anticipating reaching? Jim said they were going to run a survey shortly in three or four different areas in regard to this problem. Are you going to use it as a gourmet type item? If you go into a gourmet item and leave the price where it is, your volume is going to be highly reduced.

What are we shooting for? Are we going to shoot for volume? The growers are going to have to grow in volume. And, of course, the retailers will have to grow in volume which means a lesser price. In merchandising at retail level you've got to consider that all meat items have to be relative to other meat items.

For example, if we bought cultured catfish from Mid-Central, we would have to retail them at $1.49 to $1.59. Right now our T-bones are selling at exactly the same thing and T-bones are 50% of our volume.

Also, we discussed a moment ago, the delivery problem. This costs a lot to get the job done - particularly on a frozen item. A good example is a problem that just cropped up on delivery of fresh ice packed frying chickens in one of our areas which was a hundred and some odd miles from one of our headquarters. One of our retail members, out about 150 miles called in and complained that his price on fresh ice packed fryers was 34¢ (usually the price was 30¢). We eventually discovered that the truck delivering his chickens had driven over 500 miles and unloaded only 75 cases of chicken. This guy could have charged 50¢ a pound and still wouldn't come out. It couldn't be done because it's impossible.

Now getting back to the theory. Jim mentioned fresh versus frozen. We're approaching this quite differently. We could not handle, for example, turkeys at the holiday season if they were priced similar to a few years ago. It would be entirely impossible to move turkeys in volume to retail channels. Consequently, Jim, we have reversed the situation. If anybody wants fresh turkey they pay a premium. And I am convinced that it ought to be this way, even though your cost is slightly higher on frozen. Your chances of fresh iced packed catfish being sold at a sale on weekends and having to throw half of them away is more vulnerable as a cost factor than using frozen catfish, and selling it at or under the fresh market.

LOWELL MOHLER

At what price do you think catfish would move at retail with proper point-of-sale advertising and promotion?

PETE REESE

A survey that I took among our key personnel revealed that they thought they could do a pretty good job at $1.19. However, to move volume they said it would have to be under a dollar. I think that Jim has already made this statement. It would have to be under a dollar to accomplish the volume that we are shooting for.

LOWELL MOHLER

Let's move on to Gary.

GARY LOFF

Now you know why we don't go retail. We're not pushing retail sales, because the volume is not there at the price they have to demand. At the present time, however, we are moving more to retail sales because our volume is picking up. This is where the volume of fish will be sold in a few years. But for the next couple of years we will not have the volume to go to them. I will give you an outline on some pricing that occurs at the processor level, at the producer level, and all the way up.

If I buy fish at 36¢ per pound from the producer maybe he's making 5 or 6¢ a pound. I really don't know what margin they are setting as far as cost per pound. As the processor, I dress the fish out at 60% of recovery hopefully, which we had last year. It cost me 60¢ a pound for the raw material. I have 20¢ to work on, and it's all a matter of volume. Direct labor, overhead, distribution and advertising cost, and with volume you can get these down. If you don't have the volume you might as well forget about it. I'm wholesaling, between 85¢ and 90¢ a pound. A lot of months, particularly in the summer, I have processed over my price. My profit was over my wholesale price. If the wholesaler takes it at 85 or 90¢ and he wants his 25 or 30% markup, he goes to the retailer at $1.15.

I did mention that we sell through brokers, in Houston we go through a brokerage firm. My price then is increased 5% for his commission. So he takes the product, or he sells it to a distributor at 90-94¢ a pound. The distributor wants his 25% markup so he goes to the retailer at $1.20 or $1.25. There is no retailer in the country willing to take that product. So, he naturally has to go to the institutional market. We have had some success with the restaurateur buying at $1.20 or $1.25, but this again is not where the volume is going to be. The volume is going to be around the $1.00 market.

Presently one chain store in the Dallas-Fort Worth area is selling at the retail level to consumers for $1.29 and they're moving well. This is all fresh fish. We do know that people like fresh fish over frozen and this is one way we are convincing the people of our quality. And we do know this is the only way at the present time to get the fish into their mouths. If they eat the fish we know they'll come back.

LOWELL MOHLER

O.K. Thank you, Gary.

Let's take a quick look at the comments that our panel has had in regard to this question. Here again, by pricing it looks like the restaurants and the institutional trade will perhaps command a higher price upward to $1.29 perhaps even more. The volume will be in retail, however, but perhaps at that dollar level, in order to move them and make them competitive with other protein items. I think those of us associated with the food business can remember several years back when broilers were bringing 49-50¢ a pound before we had quantity production and efficient techniques of producing them. Now we see broilers all the time at 29¢ or at the most 33¢ a pound. Perhaps with more technology and efficient means of production, a better marketing mechanism, we can raise catfish at $1 a pound profitably for U.S. producers.

O.K., let's move to another question; one that we touched on before. And we're going to start with Gary on this one. Do we have an image problem outside the midwest with catfish? And if so, do you think this is a barrier we can break if we move the product outside the midwest?

GARY LOFF

We do have an image problem, but like I said earlier and I'll quote from someone else, "Catfish is as American as baseball and hotdogs." And I believe it. Anywhere you go in the country people know what catfish is and so you've got half the problem licked. You can compare this directly with the shrimp industry 30 years ago. People didn't even know what a shrimp was at this time, so they had to promote the idea of shrimp. We don't have to promote the name catfish, people do know what it is, but like I said, some like it, some don't. This is where the problem is, promotion is the only way we will do it. You can't expect a housewife to buy our catfish at 30 or 40 cents a pound more than wild catfish. You've got to convince her of the superior quality and how can you do this? Well, from my standpoint as manager of four co-ops, we don't have the money for promotion. The only thing we can do is put out the nicest pack and try to advertise and tell a little of the story on the label. This is what we do on our frozen retail package. This is one means that we have promoted.

Another way is through the Catfish Farmers of America or through your state organizations. The Catfish Farmers of America has to adopt an emblem which will be on every package of catfish of every processor. This will do more for the catfish industry than anything that has been done. This will be like a Good Housekeeping seal of approval. It will guarantee the customer that he is eating a farm raised catfish. Now, it is up to the processor to use the high-quality image. He's got the finest raw material in the world. It's up to him to keep the quality. And then, of course, putting that product on the market at a quality price. He has to have the price.

LOWELL MOHLER

Do you think we can break this image barrier?

GARY LOFF

Actually, I think we did a lot last year. We private labeled for a concern in Delaware and this is an area that I thought would take years to break. We also talked to people like Gorton's Corporation which is the world's largest in fish. They're interested in catfish. Booth Fisheries are interested in catfish. These people are the largest, and they know catfish can be a great asset to their line of products because of the quality. So, it's just a matter of getting it to the public, and getting it into their mouths at a low price, if you can. That's the only way you're going to do it and then you can up the price. You can't start out at $1.59 and expect people who have never heard of catfish, or don't particularly like it -- to buy it.

LOWELL MOHLER

Thank you, Gary. Pete, do you have comments on this question?

PETE REESE

I disagree with Gary in part of what he says, I wonder if the consuming public really knows what catfish is. I've been wondering if the consuming public is aware of catfish, why aren't we selling more at the retail level? This is where I'm confused.

To get this image into the minds of the consuming public it's going to take a lot of prime advertising, a lot of hard promotion, a lot of what we call POP - point of purchase material. Maybe some radio, maybe some TV, I don't know what it's going to take. But this program has to be presented to make consumers aware of catfish and how delectable they really are and their nutritional value. I suppose there are different ideas on this. And in this fat age of ours the emphasis on diet and diet control, you know, this is another point. But it's going to take money to get this story across.

LOWELL MOHLER

Gary, I believe you wanted to ask another question.

GARY LOFF

I wanted to clear up a point I made about everybody knowing what catfish is. I'm talking about the name only, I'm not talking about everybody eating catfish, or everybody liking it. They do know what catfish is, it's a fish. Second, the point is you can ask any major distributor or broker in the country today and he'll tell you he can sell a lot of catfish, but he hasn't had the supply. No one has given him the supply in twenty years and this is why more people aren't eating catfish today. Another good point is that the quality of frozen products is so poor, I'm not going to say consistently poor, but of inconsistent quality.

I ate some Brazilian catfish the other night which was just as good as farm raised catfish but you can't guarantee the quality. You might get one good truckload; you might get 10 bad ones.

LOWELL MOHLER

Good point. O.K. We'll move on to you, Jim.

JIM AYERS

The name "catfish" or image of catfish can be very important on marketing this fish. The image does in some cases have a bearing on the sale of catfish, especially outside the "catfish belt."

I believe that there is nothing that can rip the catfish industry apart and do more harm than the processors who do not have quality control programs.

The point I'm trying to make is, we have got to have good quality control within our catfish processing plants. Catfish imports are entering the U.S. and I will make mention of this in just a moment. In calendar year 1969 there was less than 4 million pounds of imported fish coming in. The odd thing about this is that our own Federal government, through the State Department, was one of the instigators of importing catfish out of South American countries. These imports were double the domestic production during 1969.

There's not much you can do about it, but we will have to guarantee our market that we will have a top quality product. Superior, not second best, not equal to. I think this, as Gary said, goes right back to the processing plant.

Advertising on a limited budget can be accomplished by "tie-ins" with large companies. To be specific, one sauce company out of New Orleans has quite a promotional program. They tie in with various fish companies, to promote the ideas of their sauce on fish.

There are a number of firms that could provide free advertising. The Catfish Farmers of America did agree that any processing plant using its emblem would have to pay into a "kitty" a certain percent to be used for promotional material.

Anything covered by the news media or periodicals will improve the image of catfish. Those of you who subscribe to American Home magazine, pay particular attention to the May or June issue. A two or three thousand word article on catfish will be appearing in this magazine. They have a circulation in this country of 4,000,000. This type of advertising is good and best of all it doesn't cost anything.

LOWELL MOHLER

Let's move on to you, John on this image thing.

JOHN SULLIVAN

I agree wholeheartedly with what has been said, particularly with Gary on this insignia they are ready to initiate. This is desperately needed.

I hope that each of you out there, if and when you get into production, are far-sighted enough to want to use this on your product and will contribute a quarter of a cent a pound to a "kitty." If all of you pull together it will raise the catfish image.

LOWELL MOHLER

You raised some real good points in regard to image and problems. Now I think we have time for just one more question. What weight of catfish for table meat, do you find most desirable?

GARY LOFF

When you talk about desirable weights, especially to restaurants, you're not talking about splitting two or three ounces - you're talking about portion control within one ounce - two ounce differentials. This is of utmost importance. This is half of your quality program. Our experience in the retail field, shows they want fish between 7 and 16 ounces.

In a specialty house or regular restaurant where they serve the whole fish they normally want a 13 ounce fish. They do not want fish over one pound. In our plant, we package two different types, one for the retail trade and one for the institutional market. A fish from 7 ounces to 1 pound goes only in a printed bag. Anything over 1 pound goes in a plain poly-bag for further processing or for sale to the institutional market. Retail takes the smaller fish and institutional takes the larger. However, there are some markets in various parts of the country which will take the larger fish. Fish markets want larger fish because people prefer buying large fresh fish rather than small ones.

Let me stress quality on portion control. Some plants in the industry were not concerned with putting out a portion control item and you can't sell fish unless it is absolutely the right weight. Particularly in steak fish you have to have portion control. This can be easily accomplished on a plant basis. A 23-24 ounce fish can be steaked for 3 sizes by 4 different girls: One on a band saw cutting steaks and three at the conveyor belt. One pulls off large steaks, one the medium size and one the small steaks. So you have portion control in one size group of steaks and portion control in one fish. This is what you need to sell fish.

PETE REESE

I think the consumer is buying on the same basis as hotels, restaurants and hospitals. He goes to the meat market and before making a purchase of any meat item runs the following through the computer in his mind - "How many individual fish is it going to take to fill up the family?" You've got five, six, seven to feed. Are you going to get one 7 ounce fish or one 14 ounce fish? The surveys I conducted revealed that they thought because of the price ratio that they should hold under 16 ounces. In other words, from 10 to 15 ounces we ought to get some good retail sales.

JIM AYERS

Size is of great importance. I think our marketing survey may come up with some concrete results. It will also look at dressed vs. non-dressed fish.

JOHN SULLIVAN

The demand of our customers is in the 16 ounce range. The biggest demand is in the 7-9 and the 11-13 range. In other words, they want an 8 ounce fish and a 12 ounce fish. We are doing some pinpoint selling on the smaller fish. We try to get some of these operators to feature a luncheon plate of five ounce catfish and use the same fish for dinner but serve two fish, or in the case of some of these outlying steak houses, serving 16 ounce catfish. They cook more uniformly, they have a little better flavor and it gives them twice as many opportunities to sell the fish as it would at 12 ounces. A man is not so apt to come in and pay $3.25 for a catfish for lunch, but he certainly would consider paying $1.60. So it gives them an opportunity to make a little money. Now, the market form that he brought up, I think is most important. Everyone is kidding himself if he thinks he can sit there, grow catfish, skin it, process it and sell it and increase their market appreciably. Catfish steaks, catfish chunks, and catfish filets are some of the new market forms that will have to be developed because in these days the American public, whether it be Mr. Nader's consumers or whether it be patrons of a particular establishment, do command different forms. The American public does not like monotony.

LOWELL MOHLER

We'll give the panelists a few minutes to sum up their key points.

GARY LOFF

To carry on a successful marketing program with farm raised catfish there are many variables to consider. They include: quality of the product, promotion and advertising, supply, packaging and price structure. Each of these will magnify as the volume increases.

Promotion and advertising are the key to a successful catfish industry. Also, package, in-store advertising, menu clip ons, all of these that you have the money to use are fine. And promotion; when you say catfish always say "farm raised, protein fed, cultured, catfish." The essence of the cultured fish industry is quality. In other fish industries the fish are processed dead on ice. They are caught in the ocean, iced down for maybe a week or a week and a half, and are brought in and inventoried on ice at the plant. Deterioration begins as soon as the fish dies. If you can retard these processes by keeping them alive then you have a good selling point.

Responsibility also lies with the producer for quality. Last fall I rejected over 300 acres of catfish that were ready for harvesting because they were musty in flavor. It is the responsibility of the producer to have a sampling program.

Then again the problem came up where I rejected 300 acres and another processor bought them. What good did that do the industry? The farmer should sample his own fish. If he doesn't want to harvest at that time, that's fine. If you want to treat your water for blue-green algae that's fine, but you should sample the fish all summer and keep that water going.

Many people think that because fish are frozen they should not lose their quality. This is not true. Freezing fish will not upgrade or improve quality nor will they hold their quality indefinitely. The methods for freezing and packaging of the product are important from a quality standpoint. Some processors are getting into trouble here. They do not know how to freeze fish properly. I will reiterate; quality will sell fish. We have got to have consistent quality 12 months of the year.

The institutional market is the big mover right now. In the future it will go to the retail market but the only way we can do this is bring the price down, hopefully not to the producer. I hope we can bring our processing cost down with new equipment, and most of all a larger supply of fish. Presently, everything in our plant is done by hand except packaging.

LOWELL MOHLER

O.K. Thank you very much. Pete?

PETE REESE

We talked about supply and how Gary produced about a million pounds a year. With 1900 stores, if we ran 100 pounds per store this would be 190,000 pounds per sale. This would be two-tenths of his supply last year. I think the thing we need to think about in summing up our story here today is how to get this story to Mrs. Consumer. What method are we going to use? What means are we going to take to educate her literally that catfish are good and good for her?

JOHN SULLIVAN

I think we have tried to appraise the catfish potential here today. There is a demand for fish of all types in the market place. And if predicted food shortages develop, the demand will be even stronger. In addition to this natural demand, we have a demand created by marketing and advertising people.

The catfish industry potential, I feel, hinges not only on the supply and the demand, but the efficiency with which they are raised and the resourcefulness which we use to sell them.

The demand is strong for catfish and certainly cultured fish has a lot of advantages over wild. The wild fish has a price advantage. However, it has many disadvantages. We know that our customers prefer to pay a few more cents per pound to have a dependable product. It must be dependable from the standpoint of portion control as well as taste.

In 8 months we sold 61,000 pounds when we took on Mr. Catfish products. This was while the salesmen were selling a product that they had to go out and develop a demand for. They had to be able to convince the customer he should pay more money for them. But it was done and can be done to a much greater extent. To get a larger share of the fish consumed I think that we, I mean you and myself, are going to have to do several things. We spoke several times of new marketing forms. I think these are very important. Gary has already pointed out the importance of portion control. Today's restaurant owner really doesn't like to talk about price per pound of fish. They want to know what that fish or steak is going to cost when cooked and put out on a platter. They want to know the exact platter cost and unless you can state definitely that this will cost you X amount he doesn't have the time or inclination to stand there and talk to you because you're really wasting time. I think it was Jim who brought out that 14% of 900 restaurants surveyed had catfish on the menu and only 3% of the 126 actually advertised that they had catfish. I think we'd better do something about that.

Take an example, cornbeef. How many of you can recall three, four or five years ago going into a restaurant on any given day and being able to order cornbeef, or cornbeef and cabbage or a reuben sandwich? There were very few places. And today if you can't get a New England boiled dinner or a cornbeef and cabbage, you can certainly get a cornbeef or a Reuben at just about every restaurant. That is merchandising. That's exactly what we have to do with catfish. It's not going to be easy. It's going to cost us money. This one fourth cent per pound would be a starter. I hope that none of you have the dire urge to talk this advertising money down because advertising and presenting your story to the public is one of the most important things you can possibly do.

I think a big step forward for the catfish farmer is to put an emblem on all brands. I rather disagree with Gary; while it is up to the processor or producer to ascertain the quality of the fish that he is going to sell, I think that the Catfish Association is going to have to put some standards on that fish and say, "This is required before you are allowed to use our seal." This would assure some continuity of quality.

I think that all of us in this room are in on the ground floor of an industry that is going to become a very large and very important segment of the commercial fishing industry. I think the prospects for profit are excellent and I think also the catfish farmers, can contribute a tremendous amount of good toward raising the status of the American commercial fisherman.

Catfish Farming Regulations

Larry R. Gale

Catfish farming is a relatively young enterprise, but one that has grown rapidly in recent years, especially in the Southeast and Midwest. As might be expected, this rapid growth has been accompanied by growing pains of various sorts. One such discomfort is evidenced by controversy over the issue of licensing and other requirements by state wildlife conservation agencies.

It is rather difficult to determine why this matter should be so controversial with some catfish farmers. Trout and minnow producers have operated for many years under similar controls without difficulty. We have seen no real evidence that licensing has hindered the growth of any efficient commercial operation. On the contrary, state wildlife agencies have conducted valuable research applicable to both public and private operations, and have helped private fish hatcheries control disease, parasites and aquatic vegetation.

Interestingly, not all state wildlife agencies concern themselves with the activities of private catfish producers. Actually the degree of control varies from absolutely none to very rigid restrictions and substantial permit fees. Most of the states without controls initially lacked or have lost the necessary authority, sometimes because they simply did not want to be bothered or felt the obligation to provide assistance would outweigh the meager income from such permits. Many states require statutory authority to regulate hatchery operations. I have made no effort to tabulate the regulations of other states because of their great variety and the rapid changes under way. The Missouri regulations lie between the two extremes and are designed: to keep the Conservation Department informed of the status and development of fish farming; to minimize the dangers of spreading undesirable fish, disease and parasites; to keep fish from other waters from being exploited for unlawful commercial purposes; and to encourage orderly growth of the industry with a minimum of restrictions.

Our basic authority is found in Article IV, Sections 40-46, of the Constitution of Missouri. Section 40 vests "the control, management, restoration, conservation and regulation of the bird, fish, game, forestry and all wildlife resources of the state . . . in a conservation commission. . .". Note that the term "fish" is not limited or restricted in any way but includes all fish. The statutory definition of "wildlife" in Sec. 252.020 R.S. Mo 1959 includes all fish. This legal interpretation is supported by the Code of Federal Regulations, Title 50, Part 13, Sec. 13.1, which states in part " 'Wildlife' refers to all species of mammals, birds, fish, mollusks, crustaceans, amphibians, reptiles, or their progeny or eggs that, whether raised in captivity or not, normally are found in a wild state." Sec. 252.030 R.S. Mo 1959 vests ownership and title to all wildlife of and within the state, whether resident, migratory or imported, dead or alive . . . in the state of Missouri. This section, actually pursuant to the Constitution, has been a point of major contention with some catfish farmers.

Through 1970, private fish producers have operated under authority of the Wildlife Breeder Permit and/or the Resident Bait Dealer's Permit. Although hatcheries have prospered under these permits and the associated regulations, the regulations lacked clarity in such matters as allowable fish harvest methods and seemed unduly restrictive regarding the sale of black bass. After much study and a public meeting to which all commercial operators were invited, a new system of permits and regulations was formulated. The new regulations have been approved tentatively by the Conservation Commission and they are expected to become official essentially as now written on January 1, 1971.

The new system replaces present permits with three new permits, each conveying different privileges. A new Fish Farming and Hatchery Permit (Fee: $25.00) will authorize complete hatchery operations, including artificial hatching and transportation. A new Fish Farming Permit (Fee: $10.00) will authorize rearing operations but not artificial hatching or transportation. These permits will cover minnows as well as other fish, frogs, crayfish, turtles and mussels. Applicants for either permit must show satisfactory evidence that: stock will be secured from a licensed commercial source; stock will be confined to prevent escape to other waters of the state and to prevent wildlife of such waters from becoming part of the enterprise; inspection by an agent of the Commission will be permitted. Any sale or shipment of wildlife must be accompanied by a written statement giving the permit number, the number and species included and the name and address of the recipient. Wildlife held under either permit may be harvested by nets, electro-fishing, seines, traps, chemicals, drainage or sport fishing methods by the permittee, his bonafide regular employees, or other agents of the permittee expressly authorized by the Commission. Sport fishing by others must be in accordance with statewide regulations. Wildlife held under either permit shall be considered the personal property of the permittee but shall remain subject to all applicable provisions of the Code.

A new Fish Hobby Permit (Fee: $5.00) will authorize the rearing of fish for fishing or direct consumption but not for sale or trade. Such fish must be obtained from a licensed commercial source and confined to prevent escape. Harvest is permitted by nets, seines, traps, chemicals or drainage by the permittee or his immediate family. Sport fishing is permitted in accordance with statewide regulations.

The new system will offer fish farmers several advantages over present regulations:

1. Many operators will need only one permit instead of two or more.
2. Rearing operations may be conducted under a lower fee than at present.
3. Allowable commercial harvest methods are specified.
4. Restrictions on sale of black bass are eliminated.
5. Personal ownership of wildlife held under the new commercial permits is recognized to the extent legally possible.
6. The new Fish Hobby Permit provides for those who want to rear fish and harvest them by commercial methods for their own use but not for sale.

Most of the fish producers who attended the public meeting or commented by letter agreed that the new regulations were superior to those now in effect and indicated their support. We have tried to overcome the objections of fish farmers to present regulations, and believe the new regulations are a reasonable improvement and in the best interest of private fish producers as well as the general public and the Department of Conservation. We seek your wholehearted cooperation in making them work for our mutual benefit.

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