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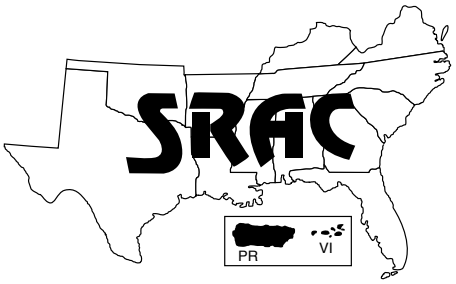

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Feeding Catfish in Commercial Ponds

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Feeding is the most important task in the intensive pond production of catfish, and the person responsible for feeding should be an experienced fish culturist. In a normal situation, catfish can be seen only when they are coming up to feed, and their feeding behavior can be an important clue to general health and to other conditions in the pond. Thus, the person doing the feeding must be able to tell whether or not the fish are feeding normally. If they are not, the feeder must inform the manager that a potential problem exists.

Nutritional requirements

Feed used in commercial catfish production must contain all essential nutrients at adequate levels to meet total nutritional requirements of catfish for normal growth and development (Table 1). Catfish feed without all the essential nutrients in the proper amounts is considered a "supplemental" feed, and has no place in modern intensive commercial catfish production operations. Unlike some other meat animal production systems, feeds used for catfish production are manufactured commercially; on-farm feed milling and preparation is not practiced.

Catfish feed manufacturers typically use a "least-cost" instead of a "fixed-feed" method of feed formulation where the formula varies, within limits, as ingredient prices change. Since the kind or amount of ingredients needed to provide essential nutrients for catfish is not a secret, feed manufacturers are typically willing to reveal the list of feed ingredients.

Form and size

The feed must not only contain all of the essential nutrients, but it must also be palatable to the catfish and of a size that can be ingested. If they don't eat it, or cannot eat it, maximum growth is not achieved and the producer loses money. The feed must be offered in such a way and at a time of day that promotes total consumption to avoid waste and increased production cost. Feed is available as meal or crumbles, and as floating, sinking, or slow-sinking feed.

The size and form to use depend upon fish size, water temperature and the type of management employed. Meal and crumbles are used for fry and small fingerlings. Although more expensive, extruded or floating feed is generally preferred when water temperatures are above 65 degrees F (18 degrees C) because feeding behavior is much easier to monitor than when sinking feeds are used. Most producers agree that the ability to see the fish eating is well worth the increased cost of floating feeds. Sinking and slow-sinking feeds are generally used when water temperatures fall below 65 degrees F (18 degrees C), since catfish reduce their feeding activity at colder temperatures and do not readily come to the surface to feed. It is a good idea to begin using the sinking feed before temperatures fall too low for floating feed, and gradually switch the fish from a floating feed to a sinking pellet while they are still actively feeding. Otherwise, if you wait until the water cools and fish feeding activity is reduced, you may have a difficult time getting the fish to accept the sinking feed.

Since multiple harvest (or topping) is the most common production scheme in commercial catfish production, the size of catfish in a pond at any given time may vary from 4 inches to above 2 pounds. Since it is not practical on a large-scale, daily basis to feed

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multiple feed sizes, most farmers compromise by feeding a 5/32- to 3/16-inch diameter pellet.

Factors affecting feeding practices

Feeding catfish is far from an exact science. It is a highly subjective process that differs greatly among catfish producers. There does not appear to be one "best" method for feeding catfish, particularly considering that numerous factors (most of which cannot be controlled) affect feeding. Even though catfish have been cultured for many years, there is still considerable variation in feeding practices on commercial catfish farms. Some catfish producers use computer programs that determine feeding rate based on a percentage of fish body weight. Feeding a prescribed amount of feed based on fish biomass in a particular pond works best when the biomass in each pond is known and a fairly accurate estimate of feed conversion can be made.

However, since most catfish producers do not clean-harvest, but remove only harvestable size fish and replace harvested fish with fingerlings, after several harvests and restockings it is difficult to accurately determine biomass. In fact, many catfish producers judge their inventory by the amount of feed fed. As a result, catfish are generally fed once daily to what is commonly called satiation (i.e., feeding the fish all they will ingest in a reasonable period of time, usually 10 to 15 minutes). Feeding to satiation is highly subjective and is often difficult to achieve in ponds containing high standing crops of fish without adversely affecting water quality.

A typical catfish production scheme includes feeding fish in various stages of their life cycle in an aquatic environment that varies widely in temperature and in quality. In addition, disease and environmental stressors often affect feeding activity. Thus, to maximize production and profits, catfish should be fed a feed that meets their nutritional requirements, according to a feeding strategy that is adapted to the specific culture conditions at any given time. That is, under normal conditions catfish should be fed as much feed daily as they will consume without adversely affecting water quality. However, depending on water temperature and other water quality parameters, and on the health of the fish, it may be prudent to restrict the daily feed allowance or to feed less frequently. How much to feed and the frequency of feeding are decisions that must be made daily by catfish producers based on each pond of fish. No two ponds of fish are exactly alike; as a result, feeding behavior in individual ponds may differ greatly or feeding activity in a particular pond may vary greatly from day to day.

Warm weather feeding

Catfish grown for food are usually stocked as advanced fingerlings of about 5 to 6 inches in length (about 50 to 60 lbs./1000 fish). They are generally fed a floating feed of approximately 5/32- to 3/16-inch diameter containing 28 to 32 percent protein (Table 1).

It is generally recommended to start with a 32 percent protein feed in early spring when the temperature is relatively low and fish are feeding with less vigor, and

Table 1. Examples of typical catfish feeds for food fish.

Ingredient	% of feed					
	(32%)[a]	(32%)	(32%)	(28%)	(28%)	(26%)[b]
Soybean meal (48%)[a]	36.5	34.5	22.5	26.3	25.5	21.3
Cottonseed meal (41%)	10.0	12.0	27.5	10.0	10.0	12.0
Menhaden meal (61%)[c]	4.0	—	4.0	4.0	—	4.0
Meat/bone/blood (65%)[c]	4.0	8.0	4.0	4.0	4.0	4.0
Corn grain	22.9	22.4	21.1	30.6	31.4	51.4
Wheat middlings	20.0	20.0	18.0	22.5	22.5	4.0
Dicalcium phosphate	1.0	1.0	1.0	1.0	1.0	1.0
Lysine-HCl	—	—	0.275	—	—	—
Catfish vitamin mix	include	include	include	include	include	include
Catfish mineral mix	include	include	include	include	include	include
Catfish oil[d]	1.5	2.0	1.5	1.5	1.5	1.5

[a]Percentage protein.

[b]Can be used for growout catfish. Catfish fed a 26 percent protein feed generally contain a higher level of body fat than those fed 28 or 32 percent protein feed.

[c]Lower levels may be used or eliminated if replaced with soybean meal on a nitrogen basis.

[d]Sprayed on finished feed pellet to reduce feed dust ("fines").

change to a 28 percent protein feed and feed to satiation as the temperature increases and the fish are feeding vigorously. However, starting with the 32 percent protein feed may be unnecessary, because there is evidence that the 28 percent protein feed can be used throughout the growout phase without detrimental effects. Protein levels as low as 25 percent may produce the same growth as feeds containing higher levels of protein if the fish are fed to satiation. The effects of such low protein feeds in mixed size populations are not clear. If there is doubt that all fish are receiving adequate amounts of feed, it is probably wise to feed at least a 28 percent crude protein feed. Because management practices vary greatly throughout the catfish industry, the individual producer must consider the various feed options and choose that which seems most appropriate to his situation.

On large commercial catfish farms, feed is typically blown onto the surface of the water using mechanical feeders that are either mounted on or pulled by vehicles. Feeds should be scattered over a large area to provide equal feeding opportunities for as many fish as possible. It is desirable to feed on all sides of the pond, but this is generally not practical on large farms where several ponds of fish must be fed in a limited period of time. Also, feed must be distributed along the upwind levee to prevent it from washing ashore.

Catfish producers usually feed once a day, 7 days a week. Feeding twice a day probably improves growth and feed efficiency. However, the logistics of multiple feedings on large catfish farms generally make it impractical. Under certain circumstances less frequent feedings may be desirable. For example, during certain disease episodes or during extremely hot weather(> 95 degrees F) it may be beneficial to feed every other day or every third day.

Feed allowance is affected by several factors, including fish standing crop, fish size, water temperature, and water quality. Water temperature has a profound effect on feeding rate as evidenced by observations in a research study (Table 2).

As fish size increases, feed consumption as percentage of body weight decreases and feed conversion increases (Table 3).

Because catfish are generally cultured using a multiple-batch production system in which several sizes of fish are present in the pond, it is recommended that they be fed to satiation. Satiation feeding appears to be particularly important when catfish are fed less often than daily. Offering as much feed as possible (without wasting feed) gives the smaller, less aggressive fish a better chance at the feed. However, with high standing crops of fish it may be impossible to satiate the fish and maintain water quality at an acceptable standard. Uneaten feed contributes to the deterioration of water quality. As a rule of thumb, feeding rates should not exceed what can be assimilated by organisms in the pond. This is difficult to judge, but generally the long-term average feed allowance should not exceed 100 to 120 lbs./acre/day. However, exceeding this rate for a few days is usually acceptable. Overfeeding should be avoided since wasted feed increases production costs by increasing feed conversion (Table 4).

Table 2. Example of feeding rate for growout catfish fed once daily to satiation from May to October in ponds stocked at a rate of 10,000 fish/acre in a single-batch system in the Mississippi Delta.

Date	Water temp. (F) 7:00 am	Water temp. (F) 4:00 pm	Fish size (lbs./1,000 fish)	Feeding rate (% bodyweight)
May 1	68	73	110	2.1
May 15	72	79	136	3.4
June 1	70	77	180	2.9
June 15	81	86	244	3.2
July 1	81	88	316	2.7
July 15	82	88	388	2.4
August 1	82	90	513	1.8
August 15	81	86	628	2.0
September 1	77	86	739	1.5
September 15	77	86	841	1.3
October 1	68	72	1,019	1.1

Table 3. Estimated feed consumption and feed conversion ratio for different sizes of catfish at optimum temperature.

Fish size (lbs./1000 fish)	Feed consumption (% body weight)	Feed conversion ratio
60	4.0 - 4.5	1.1 - 1.2
100	3.5 - 4.0	1.3 - 1.4
300	2.5 - 3.0	1.4 - 1.6
600	2.0 - 2.5	1.6 - 1.8
750	1.5 - 2.0	1.8 - 1.9
1,000	1.3 - 1.5	1.9 - 2.0
2,000	1.1 - 1.2	2.0 - 2.2
3,000	1.0 - 1.1	2.2 - 2.4

Table 4. Feed cost in cents per pound of catfish produced at different feed conversion ratios and feed prices.

	Feed price in cents/lb. (dollars/ton in parenthesis)					
Feed conversion ratio	10.0 (200)	11.25 (225)	12.5 (250)	13.75 (275)	15.0 (300)	16.26 (325)
1.3:1	13	15	16	18	20	21
1.4:1	14	16	18	19	21	23
1.5:1	15	17	19	21	23	24
1.6:1	16	18	20	22	24	26
1.7:1	17	19	21	23	26	28
1.8:1	18	20	23	25	27	29
1.9:1	19	21	24	26	29	31
2.0:1	20	23	25	28	30	33
2.1:1	21	24	26	29	32	34
2.2:1	22	25	28	30	33	36
2.3:1	23	26	29	32	35	37
2.4:1	24	27	30	33	36	39
2.5:1	25	28	31	34	38	41
2.6:1	26	29	33	36	39	42
2.7:1	27	30	34	37	41	44
2.8:1	28	32	35	39	42	46
2.9:1	29	33	36	40	44	47
3.0:1	30	34	38	41	45	49
3.5:1	35	39	44	48	53	57
4.0:1	40	45	50	55	60	65

The best time of day to feed is still debated, but the point is more or less academic. On large catfish farms, the time fish are fed is largely dictated by the logistics of feeding large numbers of ponds in a limited time period. As a result, many catfish producers start feeding early in the morning as soon as dissolved oxygen levels begin to increase. Some catfish producers and scientists argue that it is best to begin feeding midmorning or early afternoon. A study conducted in ponds in Mississippi showed no significant differences in weight gain, feed consumption, feed conversion, and survival among catfish fed to satiation at 8:30 a.m., 4:00 p.m., and 8:00 p.m.

There were also no differences in emergency aeration time among treatments. However, feeding in the late afternoon or at night in large commercial catfish ponds is not recommended because it may not be possible to aerate a commercial catfish pond as can be done in a small experimental pond. Peak oxygen demand generally occurs about 6 hours after feeding. If dissolved oxygen levels are particularly low at this time and aeration is insufficient, fish may be stressed or die. Generally, it appears most practical to begin feeding in the mid-morning after the dissolved oxygen has increased above dawn levels and is expected to increase throughout the remainder of the day.

Winter feeding

Although catfish feed inconsistently at water temperatures below 70 degrees F, a winter feeding program appears to help prevent weight loss and maintain fish health. Research has shown that fish fed during the winter gain much more weight than fish not fed. This appears to be particularly true with fingerlings. However, the weight gain of catfish not fed during the coldest winter months catches up with that of fish fed during winter when satiation feeding is resumed in the spring and summer. The health aspect of winter feeding is less well defined, but logically one would expect fish fed during the winter to be in better condition and perhaps to be more resistant to disease than fish not fed. However, there is some evidence that large catfish are more resistant to enteric septicemia of catfish (ESC) when not fed. Regardless of research data, some catfish producers do not feed during the winter months because inclement weather makes it difficult or because they simply do not see any benefit to winter feeding. Considering potential weight gains and health benefits, we feel that it is prudent to follow a winter feeding program on commercial catfish farms.

Several schedules for winter feeding of fingerlings and food fish have been suggested. Generally, water temperature dictates feeding frequency. A typical winter feeding schedule is shown in Table 5.

Since most production ponds contain mixed sizes of fish at any given time, the feeding schedule chosen should be based, in addition to water temperature, on the number of small fish in the pond, because they require higher feeding rates and more frequent feedings.

The best type of feed for winter has not been precisely defined. A typical growout floating feed containing 28 or 32 percent protein is sufficient. A 25 percent protein slow-sink feed is preferred by most producers. Either of these feeds will provide sufficient nutrition for overwintering catfish.

Table 5. Winter feeding schedule for fingerling, growout, and brooder.

Temperature	Fingerlings		Growout		Brooder	
(F)	% of body weight	Frequency	% of body weight	Frequency	% of body weight	Frequency
< 55	0.5 - 1.0	1 - 2 days / wk	0.5 - 1.0	Weekly	0.5 - 1.0	Weekly
55 - 70	1.0 - 2.5	Daily or every other day	1.0 - 2.0	Every other day	1.0 - 2.0	2 or 3 times a week

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