



GUIDELINES FOR SELECTING FEEDS AND TECHNIQUES OF FEEDING FISH

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Since feed cost represents a major portion of the cost of producing a pound of fish, careful consideration should be given to its selection and use. Once a feed is selected, proper feeding techniques need to be followed to ensure efficient conversion of feed to fish. This paper is intended to provide guidelines for selecting, buying and storing feeds, as well as for feeding fish. The information given is primarily for catfish, but should apply to other species as well.

FEEDS

Feed Selection

Proper feed selection is important from both a nutritional and economical view. A feed should deliver the necessary nutrients, and in a form that can easily be consumed by the fish. Offering the proper type and correct amount of feed will result in more efficient production and increased profits. Feed quality, type and cost should be of primary consideration when selecting a feed.

Feed quality is primarily dictated by feed composition. Although the producer does not need to know the exact chemical makeup of a feed, a general knowledge of feed composition is important. He or she should be aware that a mixture of ingredients is necessary to provide a balance of required nutrients. No single ingredient is adequate as the total nutritive source; therefore, a high quality feed should contain a blend of animal and plant proteins, as well as supplemental vitamins and minerals.

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The quality desired in a feed depends on many factors; however, it largely depends on what the producer's intent is. If he or she desires to get maximum production in heavily stocked ponds or to feed fish confined in cages, a high quality feed that provides all the essential nutrients (complete feed) should be selected. On the other hand, if he or she wishes to feed fish stocked at low densities, lower quality feeds which need not provide all essential nutrients (supplemental feed) may be adequate, i.e., a feed to supplement the natural food available in the pond.

Feed type is largely dependent on fish size and management practices. Fry require a feed of small particle size (flour or meal), while fingerlings require larger particle size (various sized crumbles or pellets) and advanced fingerlings to marketable fish require a still larger size (large pellets) feed. Selection of a feed that can easily be consumed should give the best performance.

Feed type will also depend on management practices. The bulk of feed used is for advanced fingerling to marketable-size fish, and consists of the floating (extruded) and the sinking (hard pellet) types. Most producers prefer the floating feed because of its management value; that is, they can observe the fish feeding and may be able to detect diseases or other problems. Other advantages of the floating feed include higher digestibility due to the heat applied during manufacture, better water stability and no loss of pellets in bottom muds. Its primary disadvantages are higher cost (10 to 20 percent), possible loss of certain nutrients (vitamins) during processing and increased bulk.

Sinking feeds have the advantage of being lower priced; however, management is more difficult because pellets can be lost in bottom muds and water stability of the pellets is short. Good performance can be achieved using sinking pellets if the manager is

experienced. Sinking feeds may be advantageous during winter feeding and when feeding medicated feeds. The producer should choose the type of feed that will give the best performance under his culture conditions.

Fish feed prices are relatively high in Texas, and prices are quite variable among suppliers. Savings may be realized by comparing prices. In price comparison it is wise to consider protein quantity and quality, not just total weight or crude protein alone. A 35 percent protein feed will generally be more expensive than a 32 percent protein, but on a cost per unit protein basis the 35 percent could be a better buy. Also, find out if the feed contains animal protein and, if so, what type. Feeds that contain fish meal are generally more expensive, but may be the better buy because of possible improvement in nutritional quality and increased palatability.

Producers who are able to buy in quantity may realize some savings through discounts. However, if feeds are purchased in quantity and are not used in a reasonable time, any price advantages may be lost during storage because of pellet breakage, nutrient losses or mold formation.

Feed Storage

Fish feeds are usually packaged in multi-wall bags or have plastic liners to retard moisture uptake and help protect flavor, aroma and color. Nevertheless, both bagged and bulk feeds should be stored in a cool, dry area, since climate is the most important factor determining the effectiveness of a storage area for feed. Low relative humidity is important because moisture enhances mold growth and attracts detrimental insects. High temperature may cause rancidity of oils and deterioration of vitamins in the feed. Rancid oil can be toxic, may destroy some nutrients and can cause flavor problems in the feed. Care should be taken to provide air circulation space and rodent control in the storage area. Storage time will vary depending upon environmental conditions; however, as a rule of thumb, 60 to 90 days is normally the maximum safe storage time for a fish feed. If feed is to be fed that has been stored for a considerable time, examine it for mold and staleness before feeding. Moldy feeds tend to become lumpy and discolored (bluish green) and are relatively easily recognized. Feeding a moldy feed is not recommended.

TECHNIQUES FOR FEEDING

Fry Feeding

Channel catfish fry are cultured inside in containers and in outside ponds. Culture in in-door troughs and

tanks is usually of short duration; 1 to 10 days, and is used primarily to protect the fish in the fry stage. Nutritionally complete feeds or incomplete feeds with a nutritional supplement are generally required to insure good growth and survival.

The time of the initial feeding and the frequency of the subsequent feedings is important to survival. As the yolk sac is absorbed, fry turn black and come to the water surface. They swim along the surface, especially along tank and trough sides, giving the appearance of "seeking" food. Although most of these fish will not eat the food at this time, they should, nevertheless, be offered food. This is accomplished by sprinkling the suitably-sized particles of dry food on the surface, or by placing natural foods such as finely ground organ meats, egg yolk or others in the vicinity of these fish. Frequent feeding is desired, and 8 to 10 feedings over a 24-hour period are not excessive. Frequent feeding will result in some waste of feed, and this excess must be removed from the tanks and troughs.

Fry stocked into earthen ponds as yolk sac fry, or as feeding fry, must also be fed. The mechanics of pond culture encourage the use of dry commercial feed formulations. Supplemental natural food is generally present since most producers employ fertilization techniques which encourage the production of natural fish food organisms. The feed is offered in the vicinity of the fry. The location of the fry can often be controlled by the use of tubs, boards and other "shelter" structures, since the fry desire to "hide" near the shelter. If the fry are scattered, it is best to scatter the feed along the entire shoreline. It is important to increase the particle size as the fish grow in size. No exact feed allowance can be suggested, but the amount is generally limited to 30 to 40 pounds/acre/day unless adequate water is available for exchange.

Fingerlings

Techniques for feeding fingerling fish in intensive culture are similar in many aspects to the feeding of fry. Best results are obtained by offering the particle size of dry commercial formulation suitable for the size of fish present. The feed should be spread all around the pond (if feasible) and the feed allowance should not exceed 40 pounds/acre/day unless adequate water exchange is available to dilute the waste metabolites. Fingerlings in intensive culture often overcrowd the facility and stop growing. Limited feeding will help retain the fish in good health and in good condition for short periods of time. However, it is generally better to increase the feed allowance (and the water exchange) or decrease the standing crop of fish.

Advanced Fingerlings to Marketable-Size Fish

Feeds for advanced fingerlings to marketable-size fish consist of either floating or sinking pellets. Floating feeds are preferred by the majority of catfish producers because they allow the producer to observe the fish for growth and state of health. In order to reduce the higher cost of the floating feed, some producers employ a mixture of 15 percent floating feed and 85 percent sinking feed.

Feeds should be offered in the morning only after the dissolved oxygen levels have started to increase and no later than the middle of the afternoon, to allow digestion to occur during periods of high dissolved oxygen. Fish of all sizes do not consume and assimilate feed efficiently when the oxygen levels are low.

Feed should be scattered widely over the water surface. If sinking pellets are being fed and part of the pond bottom is extremely soft, the producer must choose those feeding sites that have firm bottoms. This problem is eliminated when floating feeds are used.

Feeding rates depend on standing crops, water quality and water temperature. In the multiple stocking-multiple harvest program being employed by many producers, the number of fish and the standing crop weight per acre are high. The farmer must, then, be careful to add *only as much feed as can be metabolized by the biological system*. This can exceed 150 pounds per acre for many farms. In the single stocking-single harvest program being practiced by producers with watershed ponds, and for other producers with special needs, the producer usually tries to offer feed at a rate near 3 percent of the standing crop weight.

Producers who employ cages, net pens, and raceways often offer the amount of feed that will be consumed within 10 to 15 minutes. They may feed more than one time per day and benefit from a considerably faster growth rate and better feed conversion.

Broodfish

Feeding techniques recommended for fry and fingerling catfish are also applicable to broodfish. Broodfish should be offered a suitably-sized pellet which, due to commercial availability, will be near 3/8 inch in diameter. This pellet can be either the floating or the sinking type. A feed allowance based on 1.0 to 2.0 percent of the body weight of the fish is usually adequate.

Some producers supplement the commercial pellet by offering natural foods such as organ meats and cut/whole forage fish. Broodfish will usually consume

Table 1. Optimum Feed Particle Size for Commonly Produced Warmwater Fishes¹

Fish Size (inches)	Particle Size ²		U.S. Standard Opening	Seive Number	
Fry	Starter	•	To pass over	420 microns	40
			To pass through	595 microns	30
1/2 - 1"	#1	•	To pass over	595 microns	30
			To pass through	841 microns	20
1-1 1/2"	#2	•	To pass over	841 microns	20
			To pass through	1.19 mm	16
1 1/2 - 2 1/2"	#3	•	To pass over	1.19 mm	16
		•	To pass through	1.68 mm	12
2 1/2 - 4"	#4	•	To pass over	1.68 mm	12
		•	To pass through	2.38 mm	8
4 - 6"	#5	•	To pass over	2.38 mm	8
		•	To pass through	3.36 mm	6
6" and larger	3/16" pellet	•			

¹Adapted from: National Research Council. 1981. *Nutrient Requirements of Coldwater Fishes*. National Academy of Sciences, Washington, D.C., 63pp.

²/Number or word designation plus actual size of particle figured to right.

Table 2. Suggested maximum feeding rates and feeding frequencies for fry or small fingerling and for food-size channel catfish at different water temperatures.

Water Temperature °F	Fry Fingerlings		Food-Size Fish	
	Feeding Frequency	Feeding Rate %	Feeding Frequency	Feeding Rate %
87° and above	2 times/day	2	1 time/day	1
80° - 86°	3 times/day	6	2 times/day	3
68° - 79°	2 times/day	3	1 time/day	2
58° - 67°	1 time/day	2	1 time/day	2
50° - 57°	3rd to 4th day	2	alternate days	1
49° and below	7 to 10 days	1	3rd to 4th day	1/2

up to 3 percent of their body weight of these items at one feeding.

Winter Feeding

Feeding fish during cold weather months has become an accepted practice by some producers. However, the techniques of winter feeding vary. Some continue the basic program that they practiced in the warm weather months, except that they reduce the amount of feed offered. Others offer feed only after the water temperature has exceeded 50°F for several days, and some offer feed every 3 to 7 days regardless of the weather. Each producer must work out the program that best suits his particular situation.

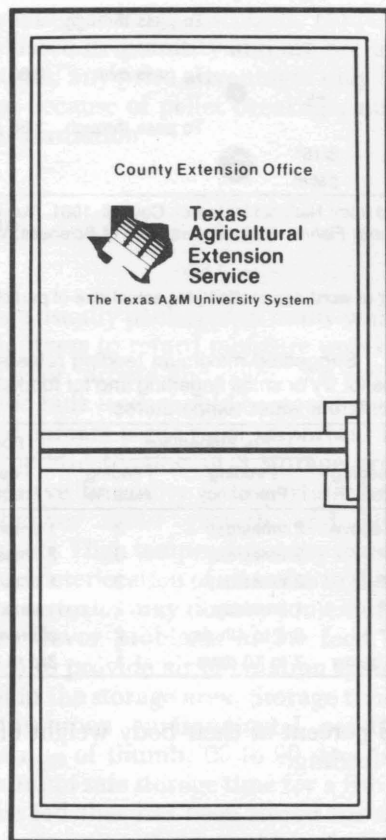
If winter feeding is practiced, the following procedures should be considered:

1. Offer feed on the warmer days. A recommended guide is 3/4 to 1 percent of fish body weight when the water temperature at 3-foot depth is 50 to 55°F or warmer.

2. Offer only the amount that the fish will eat. The recommended 3/4 to 1 percent can be altered to meet the conditions.

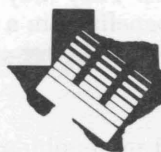
3. Offer feed where the fish are located or where they can find the feed.

Winter feeding of broodfish is recommended. Inadequate amounts of food during the winter period will result in small egg size and fewer spawns. A feed allowance based on 0.5 to 1.5 percent of the body weight of the fish is usually adequate. Feeding frequency should be no more often than each third or fourth day when the water is warmer than 50°F. When the water is colder than 50°F, the feed probably should be offered at intervals of 7 to 10 days.



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