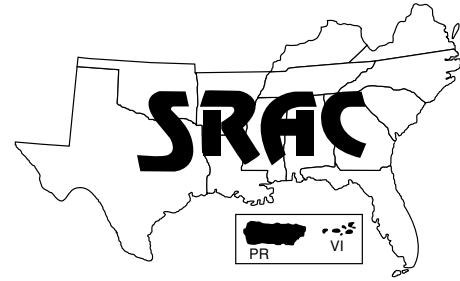


**Southern  
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## Baitfish Feeds and Feeding Practices

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The terms “baitfish” and “feeder fish” encompass a number of distinct species, each with its own nutritional requirements. Golden shiners, goldfish and fathead minnows are the three primary species raised for bait and as feeders, so this publication will focus on those species.

Using complete prepared feeds is important in modern baitfish production. While baitfish can be raised on natural foods (plankton) alone, or with just supplemental feed, economic analyses clearly indicate that a feeding program is necessary for maximizing profit.

Feeding can double or triple yields above those achieved with fertilizer alone. In enterprise budgets for golden shiner production, estimated net returns increased by 300 percent when yield was increased from 400 pounds per acre to 500 pounds per acre.

However, there are several requirements for a successful feeding program.

- There must be markets for the additional production, or else production acreage must be reduced.
- Stocking rates must be increased to maintain fish within targeted market sizes.
- Finally, there must be supplemental aeration and water quality monitoring.

Despite the increased profit potential, some baitfish farmers are understandably reluctant to feed a complete ration because feed is a

cash expense in a business where there is no guarantee that extra fish can be sold.

In the past, farmers used lots of fertilizer and raised baitfish primarily on natural foods—the planktonic “bloom” in the pond. Now, most farmers use complete feeds for sustained and dependable fish production. Feeding fish reduces or eliminates the need to fertilize ponds.

Heavy plankton blooms in shallow baitfish ponds help prevent the growth of aquatic weeds, but



Figure 1. Broodstock nutrition influences the quality of eggs and larvae.

\*Revision of the 1990 fact sheet by  
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the nutritional value of plankton in heavy blooms is questionable. Blue-green algae, in particular, may be poorly digested.

When fish are fed there is a greater risk of water quality problems, especially low dissolved oxygen. Production ponds for golden shiners and fathead minnows should have permanent aeration equipment operating at a rate of at least  $1/2$  HP per acre. Using higher aeration rates and multiple aerators likely would be beneficial, as these species do not concentrate around aerators during episodes of low dissolved oxygen. Goldfish are extremely tolerant of low dissolved oxygen concentrations. Aeration appears to stimulate goldfish growth, so regular aeration is not recommended for ponds where feeder goldfish are being held.

Ammonia can also cause water quality problems, but it is typically seen at concentrations below 0.2 mg N/L except after a bloom crash (sudden die-off of pond plankton) or as a result of overfeeding. The uneaten feed that increases ammonia can also cause hydrogen sulfide (a toxic gas) to form in pond sediments. Baitfish species are extremely sensitive to even low concentrations of hydro-

gen sulfide (reportedly as little as 5 parts per billion), so it is very important not to overfeed.

### Baitfish diets

The nutritional requirements of baitfish are similar to those of other cultured, warmwater fish species. But some things about feeding baitfish are different. Baitfish get much of their nutrition from natural foods. They can be given feed containing higher levels of fat than is found in diets for food fish, because a "fatty" baitfish is not undesirable and stored fats help maintain baitfish during the marketing process. Most cultured baitfish are young fish, from hatching to 18 months of age. Also, feeding rates for baitfish are often restricted to keep them from growing too big for market. These factors affect both baitfish diet composition and feeding practices.

### Protein

Protein is an expensive ingredient in diets. Studies show that juvenile golden shiners and goldfish grow just as well on diets with 29 percent crude protein as they do on diets with higher levels (see SRAC publication #124). Animal

proteins are apparently not needed in baitfish diets beyond the fry stage (this has not been addressed in fry). Golden shiners fed a diet formulated with all-vegetable protein performed as well as fish fed diets containing 5, 10 or 20 percent fish meal. The balance between protein and energy in fish diets is important. If a diet contains excess protein, the excess will be used for energy rather than growth, a waste of an expensive ingredient. If it contains excess energy, feed consumption will be reduced to the point that fish may not consume enough protein for growth.

### Lipids

Lipids (fats and oils) provide essential fatty acids and are a source of energy. Diets high in lipids have been tested for baitfish, because stored fats should help fish survive the marketing process. Results to date indicate differences among fish species. In a pond study, golden shiners fed high-lipid (13 percent) diets weighed less than fish fed a diet with 4 percent lipids. However, goldfish fed a 24 percent protein feed with 13 percent lipids gained more weight, showed better feed efficiency, and had higher net yields and whole-body lipids than fish fed diets with 4 percent lipids. For baitfish reared indoors, high-lipid diets must also have higher protein levels to maintain a proper energy-to-protein ratio. This is not necessarily true for culture systems with plankton (e.g., ponds), where fish can obtain the extra protein they need from natural foods.

### Carbohydrates

Starches are energy sources for baitfish species. At a fixed carbohydrate level, complex carbohydrates (starches) improved golden shiner growth more than simple sugars. Within limits, fats and carbohydrates can be used interchangeably as energy sources. Fish grow equally well on a wide range of dietary carbohydrate-to-lipid ratios, from 1:1 (equal amounts of each) to 27:1.



Figure 2. Baitfish producers use truck-mounted blowers to distribute feed.

## Vitamins

Although golden shiners in ponds do not need vitamin and mineral supplements in order to grow well, the additional cost of a vitamin-mineral premix is relatively small, and it might be of benefit in rare cases where the natural pond bloom is inadequate. Vitamin and mineral supplements may also make baitfish more resistant to stress. Vitamin C is required in the diet of golden shiners raised in indoor facilities.

## Practical diets

Baitfish farmers used to prepare diets using recommended formulas. Now those who feed complete rations purchase commercial products that are formulated on a least-cost basis, as are used in channel catfish culture. However, least-cost feed formulation can't be done as accurately for baitfish diets as for catfish, because there is no digestibility information for baitfish as yet. Manufacturers of baitfish diets use soybean meal as the main source of protein because it is relatively inexpensive and widely available. The lipid content can be increased by using full-fat soybeans. Whole-cooked corn is not well used by golden shiners, but corn derivatives such as starch, gluten and oil are readily used.

In reality, few baitfish producers purchase enough feed to warrant having a feed mill formulate a diet specifically for baitfish, and most "baitfish" feeds are actually catfish diets. However, these can be modified easily. For example, to create a high-lipid diet, increase the amount of fat added as a top-dressing (normally applied at 1 1/2 to 2 percent to control fines).

Based on research to date, a recommended growout feed for baitfish would be a catfish diet with 28 percent crude protein and 5 percent additional fat. Catfish diets usually have a total fat content of 6 1/2 to 7 percent (4 1/2 percent fat in the diet and 1 1/2 to 2 percent fat sprayed on the surface), so an additional 5 percent would increase the total fat content to 10 to 12 percent.



Figure 3. Stored fats are beneficial for maintaining baitfish through the marketing process.

Future research will focus on practical diets for baitfish broodstock and fry. Based on research with other species, the quality of the diet fed to broodstock strongly influences egg quality and the survival of young fish. In a preliminary trial, golden shiner broodstock fed a trout chow diet continued to produce eggs over the entire 2 1/2-month spawning season, while fish size almost doubled.

## Feed form

Feed can be purchased as meals (finely ground feed), crumbles (broken pellets) or whole pellets. In past research, feed form had little effect on fish yield, but the studies were conducted at relatively low densities and feeding rates where water quality was not a factor.

Commercial, extruded feeds are available in several pellet sizes. Small pellets (e.g., 3/32 inch) can be consumed whole, but are more expensive. In commercial production ponds, farmers have successfully used regular catfish pellets (1/8 to 5/32 inch) for small baitfish, as the fish are able to nibble away the softening pellets before the feed reaches the opposite bank. For routine feeding, floating

extruded feeds are better than sinking feeds.

The extrusion process increases the digestibility of certain feed ingredients, but the major advantage is that the farmer can see fish consume the feed, so that fish are not overfed.

Compressed pellets sink to the pond bottom and quickly fall apart in water; the feed particles sink into soft pond sediment. Extruded pellets normally float, but can be manufactured to be slow-sinking or sinking for winter feeding. Extruded feeds that sink will sit on top of pond bottom sediment and remain available to fish. Compressed pellets are used for "baiting in" fish for harvest; because they disintegrate rapidly, no leftover pellets are caught up with the fish in the harvest seine as happens with extruded pellets.

In a winter feeding study, fish fed a crumbled, extruded pellet were in significantly better condition (plumper) at harvest than fish fed a sinking pellet, although the two groups showed little difference in average weight. The commercial diets tested in this study were not identical, so it is unclear whether the results were strictly due to feed form or whether diet composition was also a factor.

## Feeding practices

Baitfish farmers use various approaches to feeding. Most farmers start out feeding fry meal or crumbles twice daily at a rate of 2 to 5 pounds per acre per day. Much of the feed sinks to the bottom and probably serves more as an organic fertilizer than a feed.

After 6 weeks or so, when fish reach about  $\frac{3}{4}$  inch in length, they can be switched to a pelleted feed. Some farmers feed at a set rate in all ponds, using the natural variation in stocking rate and survival to produce a variety of fish sizes. A typical daily rate for

golden shiners is 5 pounds per acre, gradually increasing to 10 or 15 pounds per acre per day. Goldfish are fed more, depending on stocking rate and desired growth. To hold fish at a given size, a farmer must know the approximate standing crop of fish in pounds per acre; fish are then fed at a rate of 1 percent body weight per day.

In baitfish production feed is a minor part of total costs but a significant operating expense. The market determines whether a baitfish farmer should adopt a feeding program.

## Sources of information

Lochmann, R. and H. Phillips. 2002. Nutrition and Feeding of Baitfish. ETB 256, Cooperative Extension Program, University of Arkansas at Pine Bluff.

### SRAC Publications:

SRAC 122, *Baitfish Production Enterprise Budget*

SRAC 123, *Feeding Practices for Baitfish*

SRAC 124, *Dietary Protein and Lipid Requirements of Golden Shiners and Goldfish*

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