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9. ABSTRACT

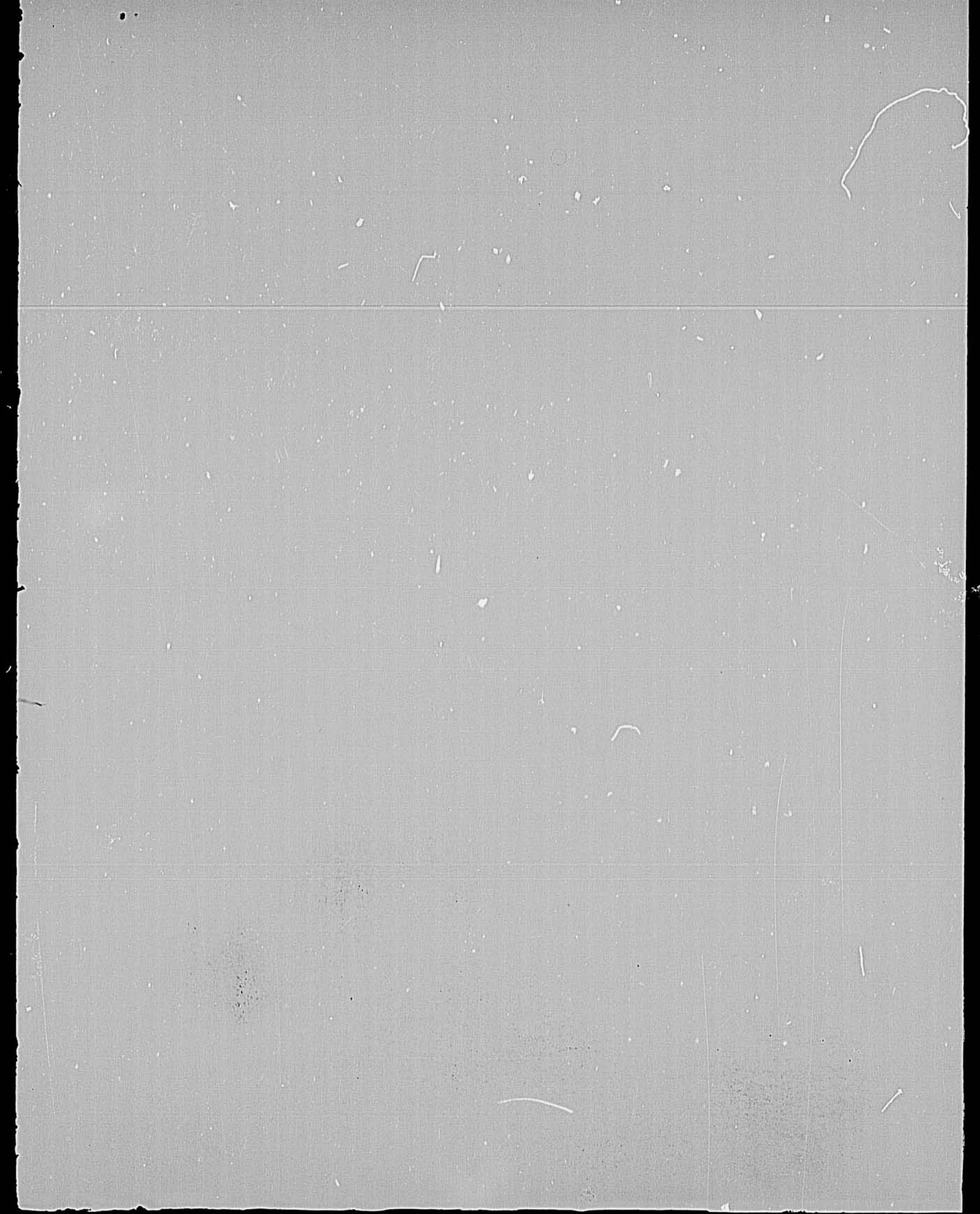
Technical reports have indicated that the optimum levels of protein feeds for growth of intensively-cultured channel catfish has ranged from 25 to 45 percent. These conclusions are based on specific percentages of protein found best for growth or profit under experimental conditions. The most important factors affecting the growth response of channel catfish to feeds containing different levels of protein are: 1) size of fish, 2) water temperature, 3) natural food available, 4) daily feed allowance, 5) amount of non-protein energy in the feed, and 6) quality of the protein. These factors, based on various experiments, are detailed in this report. All are found to have a great influence on the percentage of protein thought best for catfish feeds, and each must be considered when interpreting research data or developing productive rations.

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HOW MUCH PROTEIN IN FEEDS FOR CHANNEL CATFISH?

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Optimum levels of protein in feeds for growth of intensively-cultured channel catfish has been reported to range from 25 to 45 percent. Among the more important factors effecting the response to a specific percentage of protein by fish include: size of fish; water temperature; natural food available; daily feed allowance; amount of non-protein energy in the feed, and quality of the protein. The influence of each of these factors is discussed in detail.



FISH FEEDS AND NUTRITION

How Much Protein in Feeds for Channel Catfish?



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Fish Feeds and Nutrition

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How Much Protein In Feeds For Channel Catfish?

Editor's Note: Richard Thomas (Tom) Lovell, Ph.D. is professor of fisheries and allied aquacultures at Auburn University, Auburn, Alabama and the new chairman of the Research Committee of the Catfish Farmers of America.

His column will be a regular feature of THE COMMERCIAL FISH FARMER.

He obtained his bachelor's and master's degrees from Oklahoma State University and his Ph.D. degree in animal nutrition and biochemistry from Louisiana State University. He taught at LSU before joining the Auburn faculty in 1969. He is regarded as one of the country's outstanding warmwater fish scientists. He has been appointed to the Committee on Animal Nutrition of the National Academy of Sciences-National Research Council.

Reports in the technical literature have indicated that the optimum level of protein in feeds for growth of intensively-cultured channel catfish has ranged from 25 percent to 45 percent.

In all of these studies, the researchers were probably justified in making their conclusions that a specific percentage of protein was best for growth or profit under their experimental conditions. This is because a number of factors influence the growth response of channel catfish to feeds containing different levels of protein. Some of the most important are: (1) size of fish; (2) water temperature; (3) natural food available; (4) daily feed allowance; (5) amount of non-protein energy in the feed, and (6) quality of the protein.

SIZE OF FISH — Fish, like warmblooded animals, generally have higher protein requirements during early growth than during later phases of growth. Dr. James Andrews and associates at Georgia (1973) found that small catfish responded to higher protein levels more than did larger fish in raceways. However, in ponds, natural foods contribute significantly to the protein requirement of small catfish.

This protein is primarily of animal origin — high in quality and containing at least 50 percent protein (moisture-free basis). Thus, a significant dietary contribution from this source would reduce the protein requirement of the supplemental diet for small catfish in ponds.

WATER TEMPERATURE — Coldwater and warmwater fish respond to higher protein levels at higher water temperatures. Dr. Walden Hastings, of the Fish Farming Experimental Station at Stuttgart, Arkansas (1974), found that at temperatures below 75 degrees F, channel catfish in ponds grew no better on 35 percent than on 25 percent protein feeds. However, when water temperature exceeded 75 degrees, the fish gained more on 30 percent and 35 percent protein feed.

Dr. Hastings has contended that water temperature is a major reason for lower protein requirements for channel catfish grown in Northern ponds (Tiemeier and Deyoe of Kansas State University, 1969) than have been found with catfish grown in the lower Mississippi River Delta (Hastings, 1969).

NATURAL FOOD AVAILABLE — The natural pond food consumed by catfish is an excellent protein source. The importance of this supply is influenced by natural pond productivity and the number and size of fish per acre of pond space.

To demonstrate the effect of pond stocking density on growth response of channel catfish to feeds containing two levels of pro-

tein of similar quality, earthen ponds at Auburn University were stocked with 2,000 or 4,000 fish per acre and fed supplemental feeds containing either 32 percent or 45 percent protein. Daily feed allowance was increased as the fish grew until it reached 35 pounds per acre per day — then remained at this level until the ponds were harvested. The results were:

Dietary Protein Stocking Density		Yield	Feed Conversion
(Percentage)	(Fish / acre)	(lb / acre)	Ratio
45	4,000	3,412	1.16
32	4,000	2,446	1.65
45	2,000	2,200	1.34
32	2,000	2,030	1.45

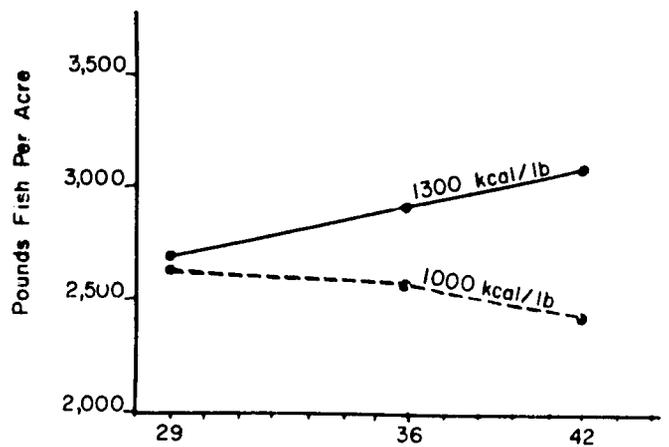
Under those cultural conditions, the difference in weight gains from the two feeds was appreciably greater when 4,000 fish were stocked per acre than when there were half that many fish per acre. One reason for this difference is that the natural productivity of the pond contributed more protein to the diets of the fish in the ponds where there were fewer fish.

DAILY FEED ALLOWANCE — For maximum rate of growth, channel catfish need a certain quantity of protein (as well as other nutrients) in their daily food intake. This quantity depends upon characteristics of the fish, water and diet. Thus, it follows that the protein percentage in the supplemental feed must be higher in order to meet the fish's daily protein need, when the daily feed allowance is, for example, 1.5 percent of fish weight instead of 3 percent — assuming that the supplemental feed is the fish's primary source of protein.

Traditionally, 30 to 40 pounds of feed per acre per day have been considered the maximum safe level for static ponds (higher levels are used where additional water is available). Higher inputs are more likely to cause oxygen depletions and excessively dense phytoplankton blooms. Following this precaution, we stocked channel catfish fingerlings at 2,000 and 4,000 per acre and fed 32 percent or 45 percent protein feeds for 200 days. Growth responses of fish (as shown in the previous table) were evidence that — when the high stocking density was used and maximum daily feed allowance was limited to 30 to 40 pounds per acre — the 32 percent protein feed did not provide enough protein.

At Auburn, we have found that 3,000 channel catfish per acre can be grown to 1-pound size in 200 days in static ponds, not feeding above 30 to 40 pounds per acre per day and using feeds containing 35 percent good quality protein. Studies at other Agricultural Experiment Stations where lower protein levels were found to be optimum involved either less fish production per acre or higher feeding rates.

NON-PROTEIN ENERGY — Energy from starches and fats may spare protein in catfish rations. A pond feeding study was conducted at Auburn to compare the effects of different ratios of protein to energy in the feed on growth of channel catfish in ponds. Feeds of three protein percentages (29, 36 and 42 percent) and two metabolizable energy levels (1,000 and 1,300 kcal per pound) were fed to the fish for 200 days. The two lines on the following graph represent the growth of the fish fed the high energy and low energy feeds at different protein levels:



Yield of catfish per acre from diets containing three protein percentages at high and low energy levels fed for 165 days in earthen ponds.

At the lower energy level, the fish did not increase their weight gain as level of protein in the feed increased. At the higher energy level, weight gain increased with each increase in protein percentage.

Interestingly, the poorest response was from fish fed the highest protein — low energy feed. Apparently, this diet contained too little non-protein energy for the high level of protein. These results indicate that perhaps a high level of protein in the presence of a small amount of non-protein energy in catfish feeds may be harmful.

QUALITY OF PROTEIN — To provide information on the effect of the quality of protein in catfish rations on optimum level of protein, we developed nine test diets and fed them to channel catfish in 27 ponds over a 198-day growing period. The nine diets con-

tained three percentages of protein (28, 36 and 43 percent) supplied in either an all-plant feed, a feed in which a small part (1/6) of the protein was from fish meal, or a feed in which a moderate portion (1/3) of the protein was from fish meal.

Production responses from the test feeds were:

Protein	Diet	Fish Meal	Yield (lb / acre)
28%		0	2,300
36%		0	2,470
43%		0	2,640
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29%		1/6	2,440
36%		1/6	2,910
43%		1/6	3,010
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29%		1/3	2,760
35%		1/3	2,940
43%		1/3	3,030

In the all-plant (0 fish meal) diets, the yield of fish increased as the level of protein went up. However, when a small amount of fish meal was included, very little additional yield resulted when the protein level was increased above 36 percent. Increasing the fraction of fish meal from 1/3 to 1/6 made a difference in yield only at the 29 percent protein level. These results indicate that the better balanced the protein is in essential amino acids, the lower the total amount required to meet the fish's need for growth.

The factors discussed in this column, size of fish, temperature, available natural foods, feed allowance, protein-energy ratio and quality of protein — all have a profound influence on the optimum percentage of protein in catfish feeds, and each must be considered when interpreting research data or developing productive rations.