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FOOD HABITS OF HYBRID BUFFALOFISH, TILAPIA, ISRAELI CARP AND CHANNEL CATFISH IN POLYCULTURE

by
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ABSTRACT

Channel catfish were cultured alone, and in combination with *Tilapia aurea*, Israeli carp, and hybrid buffalofish in 0.1-acre earthen ponds. Studies were conducted on the stomach contents of these species in May, July, and October. During the study the stomachs of 243 channel catfish, 17 adult hybrid buffalofish, 85 fingerling hybrid buffalofish, 157 tilapia, and 7 Israeli carp were examined. Supplemental feed comprised 87% of the channel catfish diet, 58% in the tilapia, 42% in the adult hybrid buffalofish, 56% in the hybrid buffalofish fingerlings, and 87% in the Israeli carp. Net yields of channel catfish were reduced with the polyculture combinations used.

INTRODUCTION

Most commercial fish production in the United States has been devoted to monoculture. Recently, however, fish culturists have become interested in polyculture of hybrid buffalofish *(Ictiobus cyprinellus* x *I. niger), Tilapia* spp., and Israeli strain of common carp *(Cyprinus carpio)* as accessory species with channel catfish *(Ictalurus punctatus).* The goal of such polyculture is more efficient utilization of the food niches within the pond ecosystem. No research has been conducted to determine if there is competition among the channel catfish, hybrid buffalofish, *Tilapia aurea* and the Israeli carp.

The purpose of this study was to determine (1) competition for supplemental feed added to the ponds, and (2) utilization of natural fish food organisms.

MATERIALS AND METHODS

Twenty-two, 0.1-acre earthen ponds averaging three feet deep were used for this study during the months of March through October, 1974. These ponds are part of the R-series of the Fisheries Research Unit of the Auburn University Agricultural Experiment Station, Auburn, Alabama.

Treatments

Channel catfish and *Tilapia aurea* were obtained from holding ponds and tanks on the Auburn Station. Adult and fry of hybrid buffalofish and Israeli carp were obtained from the Fish Farming Experimental Station, Bureau of Sport Fisheries and Wildlife, Stuttgart, Arkansas. Data indicating stocking combinations, rates per pond, and dates are shown in Table 1.

Auburn No. 4 catfish feed (sinking pellets, 36% protein) was fed to channel catfish only six days per week from March 30 to September 9. Fish were fed seven days per week from September 10 to October 16. Amount of feed fed was based on 3-5% of the estimated weight of the catfish, with maximum daily allowance of 35 pounds per acre. All ponds received equal amounts of feed.

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Table 1. Stocking combinations and numbers of fish stocked per pond in polyculture research, 1974.

Pond	*Channel[a] Catfish*	*Tilapia[b]*	*Hybrid Buffalofish[c] Fingerlings*	*Hybrid Buffalofish[d] Adults*	*Israeli[e] Carp*
R- 4, 23	300				
R-28, 32	300			10	
R-21, 27	300		100		
R- 5, 6	300	25			
R-19, 30	300	25		10	
R-20, 24	300	25	100		
R- 1, 26	300	50			
R- 2, 3	300	50		10	
R-22, 25	300	50	100		
R- 7, 10	300	25			5
R- 8, 31	300	25			10

[a]Stocked March 22, 1974.
[b]Stocked April 16, 1974.
[c]Stocked April 2, 1974.
[d]Stocked June 22, 1974.
[e]Stocked March 31, 1974.

Table 2. Date and number of fish sampled, length range of fish, mean fish length, and average weight of fish removed from R-ponds during 1974 polyculture research.

Species	*Date*	*Number Sampled*	*Total Length (mm)*	*Mean Total Length (mm)*	*Average Weight*
Channel Catfish	May	22	130-180	155.4	40.64 g
	July	22	203-330	243.8	144.96 g
	Oct.	203	262-418	337.1	454.64 g
Tilapia	May	14	80-110	94.7	18.80 g
	July	70	51-185	80.6	19.03 g
	Oct.	73	56-149	99.5	24.83 g
Hybrid Buffalofish Adult	May	3	500-500	500.0	2.27 kg
	July	3	480-555	521.0	2.20 kg
	Oct.	11	406-537	485.0	3.12 kg
Hybrid Buffalofish Fingerlings	July	30	81-110	96.6	17.9 g
	Oct.	59	132-240	179.0	138.26 g
Israeli Carp	May	1	181-181	181.0	124.9 g
	July	2	316-345	330.0	894.65 g
	Oct.	4	215-375	305.5	1.5 kg

Collection of Samples

To reduce the effect of removal of fish samples on yield, only one-half of the replicate ponds were sampled on May 4 and the other half on July 13. With the exception of R-1, all ponds were sampled on October 5. Fish removed from each pond were replaced with fish from a nearby holding pond to reduce effects of sampling. Table 2 shows weight, length, number, and date fish were sampled.

Fish were seined approximately one hour after supplemental feed was added to the pond. Sampled fish were immobilized in the field by pithing, and the gut cavities were injected with 10 percent formalin. The fish were then placed in numbered plastic bags and placed in ice.

In the laboratory all stomachs were removed and placed in 10% formalin until the contents could be examined.

In the buffalofish and tilapia, the anterior third of the intestinal tract was examined. This portion contained representative food items with the least degree of digestion.

In the channel catfish and Israeli carp, the stomach was examined. In those channel catfish sampled in October, the remainder of the intestinal tract was examined for presence of tilapia.

Samples of supplemental feed pellets and fines (small particulate materials from the pellets) were moistened and used for comparison with the stomach contents of the fish.

Analyses of stomach contents were recorded as estimated percent of total volume composed by each item (Pillay, 1952).

Only those stomaches containing food items are reported. The percentages of food items found were averaged for species during the study.

Food items were placed in the following major categories: supplemental feed, mollusca, unicellular algae, filamentous algae, adult insects, insect larvae and cases, debris, and entomostraca. The category debris includes sand, mica particles, and unidentifiable plant or animal materials. The term entomostraca as defined by Barnes (1968) was used for grouping copepods, cladocerans, and ostracods.

RESULTS AND DISCUSSION

Channel Catfish

In this study, supplemental feed was the primary food of the channel catfish in polyculture (Table 3).

Table 3. Stomach contents of channel catfish from R-ponds combined for May, July, and October, 1974, expressed as average percent volume.

	Food Item						
Pond	*Supplemental Feed*	*Insect Larvae*	*Mature Insects*	*Unicellular Algae*	*Mollusca*	*Debris*	*Tilapia*
R-4, 23	85.0	5.0	T		1.8	8.0	
28, 32	85.7	2.0	T			11.7	
21, 27	71.4	T[1]	T			28.2	
5, 6	90.7	T				8.6	
19, 30	89.0	2.7		T		8.0	
20, 24	89.7	T		T		10.0	
1, 26	85.0	6.2				8.6	
2, 3	88.7	T			T	10.5	
22, 25	90.4				T	7.7	T[2]
7, 10	94.1					5.2	T[3]
8, 31	91.8					7.1	

[1] Trace less than 1 percent.
[2] From fish sampled in October.
[3] From fish sampled in October.

Devaraj (1970) reported that channel catfish were omnivorous in their feeding habits. However, supplemental feed made up the largest portion of the diets on days it was added to the ponds. He found that chironomid larvae and mollusca were the primary foods consumed on days when supplemental feed was not added to the ponds.

Channel catfish were reported by Smith (1973) to prey on juvenile tilapia in culture ponds. He found that channel catfish stocked at 7,000 to 10,000 per acre were responsible for a 70 to 80% reduction in tilapia reproduction regardless of tilapia stocking rates.

In this study catfish averaged 155 mm in May and 244 mm in July (Table 2). Tilapia remains were not present in stomachs of fish sampled at those times. Catfish sampled in October averaged 331 mm total length, and 1% of the stomachs contained tilapia remains. Channel catfish have been considered piscivorous at 375 mm (J. S. Dendy, personal communication). It appears that prior to July, channel catfish had not reached a size where they would feed on tilapia. However, this may also indicate that up to this time catfish were receiving a sufficient amount of supplemental feed. In August and September catfish appeared to be feeding on small tilapia at the surface when supplemental feed was added.

During the week of October 5 when ponds were sampled, water temperatures averaged 15°C. Since channel catfish feed best at temperatures above 21°C, this may have been a contributing factor in the low percentage of the stomachs which contained tilapia.

Tilapia aurea

Results of this study indicate the omnivorous feeding habits of tilapia in polyculture (Table 4). Entomostraca, unicellular algae and debris were the primary natural food items utilized. However, supplemental feed was found in greatest abundance, ranging from 53 to 62% where tilapia were stocked with channel catfish and Israeli carp, and with channel catfish and hybrid buffalofish. Feed was found in least amounts where tilapia were stocked at 250 per acre with channel catfish.

Tilapia aurea examined from catfish culture ponds have been found to contain supplemental feed (Smith 1973). This was in agreement with Miller (1972) who found tilapia in catfish culture pens fed on supplemental feed and to a lesser extent on plankton which was in abundance.

Table 4. Stomach contents of *Tilapia aurea* combined for May, July, and October, 1974, expressed as average percent volume.

Pond	*Food Item*					
	Supplemental Feed	*Entomostraca*	*Insect Larvae*	*Unicellular Algae*	*Filamentous Algae*	*Debris*
R- 5, 6	53.1	14.7		3.9		28.1
R-19, 30	55.6	4.0		10.0	T[1]	28.7
R-20, 24	59.9			25.1	T	15.7
R- 1, 26	59.8	4.0	3.8	3.5		29.8
R- 2, 3	62.0	10.7		9.9		16.7
R-22, 25	56.5	15.7		11.7		16.1
R- 7, 10	62.2	12.2		2.3	T	23.2
R- 8, 31	58.1	10.2	4.0	4.5		23.2

[1] Trace less than 1 percent.

Table 5. Stomach contents of hybrid buffalofish combined for May, July and October 1974 expressed as average percent volume.

	Food Item					
	Pond	*Supplemental Feed*	*Entomostraca*	*Filamentous Algae*	*Unicellular Algae*	*Debris*
Adult	R-28, 32	50.6	33.3	T[1]	T	14.5
Buffalofish	R-19, 30	24.6	15.3			59.3
	R- 2, 3	53.7	32.8		T	13.3
Fingerling	R-21, 27	37.6	29.5			32.5
Buffalofish	R-20, 24	59.5	18.2		3.8	19.2
	R-22, 25	73.3	11.1		T	14.8

[1] Trace = less than one percent.

Hybrid buffalofish

In polyculture there appears to be no significant difference between food habits of adult and fingerling buffalofish. Entomostraca and supplemental feed were the two major food items found (Table 5). Ostracods were the most abundant entomostraca.

Composition of the supplemental feed was small particle sizes such as found in fines or feed that had disintegrated in water.

The small particles of supplemental feed and debris in the stomachs suggests that the buffalofish utilizes the pelleted feed once it has disintegrated in the pond water. However, fish in aquaria were observed to pick up pellets and to expel them from their mouths. The buffalofish may be able to selectively feed on components of the pellet by grinding them with the pharyngeal teeth and by pumping the feed over the gill rakers (J. Ramsey, personal communication).

The mouth of the hybrid buffalofish is subterminal. The stomach is not well defined, and the intestine length averages 2.7 times body length.

Physical characteristics and food habit data gathered in this study indicate that the hybrid buffalofish is primarily a benthic feeding omnivore. However, it appears that supplemental feed was an important constituent of the diet.

Data collected in this study also indicates the hybrid buffalofish has food preferences similar to those of bigmouth buffalofish (Jarman 1968).

Bigmouth buffalofish fingerlings stocked in ponds have been reported to feed primarily on chironomids and entomostraca (Shira 1918). According to Jarman (1968) the bigmouth buffalofish retains the food habits of wild fish when ponds do not receive supplemental feed. He found that in unfed ponds bigmouth buffalofish fed primarily on entomostraca and debris, but buffalofish selected supplemental feed when presented, even though there was an abundance of entomostraca in the pond.

Table 6. Stomach contents of Israeli carp combined for May, July, and October, 1974, expressed as average percent volume.

	Food Item		
Pond	*Supplemental Feed*	*Insect Larvae*	*Debris*
R-7, 10	94.0		6.0
R-8, 31	81.0	2.0	17.0

Israeli carp

Chaoborus larvae, and chironomid larvae and adults were preferred food items of Israeli carp examined by Kilgen and Smitherman (1971).

Insect larvae in this study comprised very small amounts of the stomach contents (Table 6). Supplemental feed was of greatest importance averaging 87% of the stomach contents. Debris was second in importance, averaging 12% of the contents.

From the data obtained, the Israeli carp appeared to utilize primarily supplemental feed in polyculture with channel catfish and *Tilapia aurea.*

Effect of polyculture combinations on catfish growth

Net yields of channel catfish were similar when stocked alone and in combination with 250 tilapia per acre (R. Pretto, Graduate Research Assistant, Auburn University Fisheries Department, personal communication regarding research in progress). Tilapia at stocking rates of 500 per acre significantly reduced yields of channel catfish. This is similar to results found by Smith (1973).

The data suggests that at the lower stocking density tilapia did not utilize sufficient amounts of supplemental feed to suppress the growth of channel catfish. However, it may also indicate that channel catfish fed on young tilapia even though only small numbers were found in catfish sampled in October.

Lowered net yields of channel catfish were produced in combinations with hybrid buffalofish, tilapia + hybrid buffalofish, and tilapia + Israeli carp, (R. Pretto, Graduate Research Assistant, Auburn University Fisheries Department, personal communication regarding research in progress). It appears that with the stocking combinations used the fishes competed for supplemental feed to the extent that catfish growth was suppressed.

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POLYCULTURE STUDIES WITH CHANNEL CATFISH AND BUFFALO

by

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ABSTRACT

Polyculture studies were conducted in coastal brackish ponds evaluating buffalo *(Ictiobus* spp.) and channel catfish *(Ictalurus punctatus)* combinations. The 1973 and 1974 southwest Louisiana studies demonstrated feeding to be necessary, without it, buffalo were found to compete with catfish for natural foods. Bigmouth buffalo *(I. cyprinellus)*, black buffalo *(I. niger)* and bigmouth x black hybrid buffalo when stocked at 100 per acre with 1,600 and 2,000 catfish did not compete to any extent for supplemental feed. Addition of buffalo in some ponds actually resulted in increased catfish production. Results showed average buffalo production ranged up to 300 pounds per acre in addition to catfish production. The stocking of buffalo will supplement incomes where the demand for this fish is high.

INTRODUCTION

In the southeastern United States, polyculture of catfish *(Ictalurus* spp.) with buffalo *(Ictiobus* spp.) probably originated in Arkansas in the early 1950's. Early reports indicate pioneer farmers stocked from 30 to 100 buffalo fingerlings with 20 to 75 catfish fingerlings per acre (Stevenson, 1958). Harvest of the unfed ponds began in 15 to 18 months, with total production ranging from 200 to 1,000 pounds per acre. White (1971) reported catfish farmers stocking catfish, buffalo and minnows annually harvest approximately 500 pounds catfish and 500 pounds buffalo per acre without feed. Another report described a total production of 709 pounds per acre without feed. The pond had been stocked at a rate per acre of 125 bigmouth buffalo *(I. cyprinellus)*, 50 channel catfish *(Ictalurus punctatus)*, 50 white catfish *(I. catus)*, 100 crappie *(Pomoxis sp.)*, 25 flathead catfish *(Pylodictis olivaris)* and five Israeli carp *(Cyprinus carpio)* for approximately 1 ½ years (Bureau of Sport Fisheries and Wildlife, 1965). They also reported a harvest of 3,000 pounds per acre when higher stocking rates were used and fish fed.