SURVIVAL OF BLUE AND CHANNEL CATFISH JUVENILES STOCKED IN PONDS WITH ESTABLISHED PREDATOR AND FORAGE FISHES

by

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ABSTRACT

Survival of juvenile blue catfish (Ictalurus furcatus; 60-95 mm TL) and channel catfish (I. punctatus; 42-60 mm TL) stocked together in three research station ponds (0.51-1.0 ha each) containing established populations of largemouth bass (Micropterus salmoides) and forage fishes was monitored in an effort to determine post-stocking survival. These data were also compared to earlier estimates for 10-20-mm TL blue and channel catfishes where virtually no post-stocking survival was found.

Immediately following transport from the production hatchery to the research station, survival of 1,609 blue catfish and 1,657 channel catfish was 96.6% and 99.9%, respectively. Survival 24 hours after acclimation and pond introduction of groups of 50 of each species was 76% and 100%, respectively. However, because test fish arrived at the research station in a stressed condition, the remainder of the specimens were held in indoor tanks and medicated until their condition improved. After 7 days in medicated tanks followed by acclimation and release into test ponds, 24-hour post-stocking survival for 674 of each species was 99.6% for blue catfish and 99.7% for channel catfish. Subsequent survival after 9 weeks in test ponds was 3.9% and 6.7%, respectively.

In general, no statistically significant differences in N/pond of catfish recovered or percent survival between catfish species or test ponds was found. However, significant differences were found between catfish species and N/ha recovered with greater survival among channel catfish despite their having been stocked at a smaller size. A significant difference was also found between catfish survival and number of largemouth bass present whereby bass density (N) impacted catfish survival more significantly than bass biomass (kg).

INTRODUCTION

Both blue catfish (*Ictalurus furcatus*) and channel catfish (*I. punctatus*) are highly sought food and game fishes, and are the most abundantly cultured ictalurids (Bardach et al. 1972). In Texas, channel catfish are reared and widely stocked in large numbers by the Texas Parks and Wildlife Department (TPWD) to support recruitment of existing populations. Blue catfish are also produced and stocked by TPWD, but in fewer numbers and at fewer locations.

Although TPWD has historically stocked 25-50-mm TL blue and channel catfishes, preliminary work by Howells (1989) on post-stocking survival of 10-20-mm TL blue and channel catfishes resulted in no survival of the blue catfish and recovery of only two of 1,695 channel catfishes after 14 weeks in ponds containing established populations of largemouth bass (*Micropterus salmoides*) and forage fishes. However, the survival rates of these catfishes when stocked at sizes larger than 20 mm TL has not been evaluated in Texas waters.

Small young-of-the-year channel catfish often suffer substantial losses when stocked into waters containing predaceous insects, largemouth bass, bluegill (*Lepomis macrochirus*), and redear sunfish (*L. microlophus*) (Marzolf 1957; Crance and McBay 1966; Miller 1966; Krummrich and Heidinger 1973; Powell 1976). Similar predatory impacts on young blue catfish, or comparative survival between both catfishes, are undocumented.

This study compares survival of 60-95-mm TL blue and 42-60-mm TL channel catfishes when stocked together into ponds containing established populations of largemouth bass.and forage fishes. Also, it contrasts survival of these larger juveniles to that previously reported (Howells 1989) for recently transformed (yolk-sac absorption) blue and channel catfishes (10-20 mm TL) stocked into these same ponds earlier.

MATERIALS AND METHODS

Three, 0.51-1.00-ha ponds at Heart of the Hills Research Station (HOH), Ingram, Texas, were stocked with largemouth bass at rates of 83.3 kg/ha (N=164), 95.5 kg/ha (N=82) and 98.4 kg/ha (N=144) in October 1988. Forage fishes stocked into ponds prior to bass introductions, or added thereafter, included: goldfish (*Carassius auratus*), gizzard shad (*Dorosoma cepedianum*), golden shiner (*Notemigonus crysoleucas*), fathead minnow (*Pimephales promelas*) and green sunfish (*L. cyanellus*) (Table 1).

Blue and channel catfish juveniles were obtained from TPWD hatcheries and transported to HOH on 27 July 1989 using standard hatchery transport procedures and equipment (C. W. Bowling, TPWD, San Marcos; personal communication). Catfish lengths, 60 to 95 mm TL in blue catfish and 42 to 60 mm TL in channel catfish, represented the only sizes available from TPWD hatcheries at that time (e.g., equivalent size groups of both species were not concurrently available). Blue catfish were in poor condition before transport began. Hatchery personnel suggested possible infection of *Flexibacter columnaris*. Therefore, upon arrival at HOH, both groups of catfishes were isolated in 946-liter indoor tanks for treatment before stocking in test ponds, except 50 specimens of each species were placed directly in wood-frame boxes covered with plastic netting (0.5-mm bar mesh) and subsequently placed in an additional research station pond (identical to test ponds, but where possible infection would not present problems) to examine 24-hour post-transport survival. The remainder were treated once with 3% sodium chloride and 20 mg/L furacin which was added to each of the holding tanks for approximately 2 hours of static exposure, then slowly diluted by flushing with flow-through spring water.

Seven days after arrival, all specimens were judged free of major infections and stocking procedures were conducted at 247/ha/species in the three research station ponds. Stocking was done by holding the desired numbers of specimens (N=188, 238 and 248 of each species) in wood-frame cages covered with plastic netting (0.5-mm bar mesh) in each test pond to monitor short-term post-stocking survival. Twenty-four hours later, specimens in each cage were designated live or dead (no signs of respiration or movement, failure to respond when prodded), measured (nearest mm TL), and counted, then released. Any specimens which died during this 24-hour post-stocking period were replaced with additional specimens to maintain designated stocking rates.

From 23 through 25 October 1989, the three test ponds were drained and all fishes were removed, counted and weighed (nearest 0.1 kg) by species. Catfishes were individually measured (nearest mm TL) and weighed (nearest g).

Long-term survival data were subjected to t-test, X^2 and simple regression analysis (Steel and Torrie 1960) with significance set at $P=0.05$.

RESULTS AND DISCUSSION

Following the 2-hour transport from the production hatchery to the research station, survival upon arrival was 96.6% of 1,609 blue catfish and 99.9% of 1,657 channel catfish. Survival of blue catfish juveniles 24 hours after transport was 76.0% of 50 and that of channel catfish was 100% of 50. Post-stocking survival (+24 hours) was 99.6% of 674 blue catfish and 99.7% of 674 channel catfish. Holding catfish in culture tanks before pond stocking is atypical of standard stocking methodology at reservoirs and may well have favorably benefited survival.

At draining in October, both species were recovered from each of the three test ponds. Blue catfish survival ranged from 1.6 to 9.0% after 9 weeks in test ponds, and channel catfish survival ranged from 2.8 to 16.0% (Table 2); however, differences were not significant ($F=2,443.087$). The number of each catfish species recovered per pond was not significantly different (blue catfish, $F=0.014$ and channel catfish, $F=0.024$). TPWD hatchery personnel generally expect a return of 90% or more from hatchery ponds (predation free) stocked with blue or channel catfish fry for growout (C. W. Bowling, TPWD, San Marcos; personal communication) prior to transport for reservoir stocking.

Although the number and biomass of largemouth bass in the three test ponds was high (Table 1) and undoubtedly lowered catfish survival, similar or higher largemouth bass densities occasionally occur in some Texas reservoirs. Also, all three test ponds were almost totally free of vegetation and other structure that could have provided cover for catfishes, and subsequently enhanced survival. It seems reasonable therefore to expect higher catfish survival rates in reservoirs where predator densities are lower, where protective cover is available, or both.

Mean and range in length at recovery in October was 114.1 mm TL (107-130 mm TL) for blue catfish and 110.3 mm TL (75-140 mm TL) for channel catfish (not significantly different; $\underline{t}=0.639$). Mean and range in weights were 8.2 g (2-15 g) for blue catfish and 8.9 g (7-14 g) for channel catfish. Number and weight of largemouth bass and forage fish biomass recovered concurrently are presented in Table 1.

Survival of channel and blue catfish juveniles stocked at 247/ha/species (6.7 and 3.9%, respectively) was far better than observed for yolk-sac stage catfishes stocked at a rate of 682/ha/species (< 0.1 and 0.0%, respectively) in these same test ponds in 1988 (Howells 1989). Clearly, although 42-95-mm TL catfishes are still subject to largemouth bass predation, survival can be expected even under high predator density and no-cover situations, whereas 10-20-mm TL catfish appear to have little post-stocking survival.

Smith and Swingle (1942), Brown (1952) and others have stressed the need to consider survival rate before stocking fishes. Krummrich and Heidinger (1973) found only 203-mm-fork length (FL) or greater channel catfish were free from largemouth bass predation, although some catfish 178 mm FL were killed but not eaten. Similarly, Powell (1975) recommended stocking 152-203-mm catfish to avoid largemouth bass predation.

Nearly twice as many juvenile channel catfish (N=45) than blue catfish (N=26) were recovered from test ponds in this study. Differences in total number of each species recovered were not significant ($\underline{t}=-0.737$), but were significant in N/ha recovered ($X^2=20.09$, $P < 0.001$), indicating better survival of channel catfish juveniles despite their smaller size at stocking.

The largest number (N=47 total) and density (61.78/ha) of catfish recovered from a single pond was taken from the pond with the largest biomass of largemouth bass (111 kg/hectare versus 75 and 95) but the smallest number of largemouth bass (105/hectare versus 121 and 152). The number of blue and channel catfishes recovered was significantly different from the corresponding largemouth bass number per pond ($\underline{F}=1.043$ and 1.179, respectively). Likewise, the number of blue and channel catfishes recovered was significantly different than the weight of largemouth bass per pond ($\underline{F}=2.656$ and 2.381, respectively). Apparently, once largemouth bass became large enough to prey upon small catfishes, density of largemouth bass present rather than size was the deciding factor in catfish survival. If true, this fact may need to be considered when planning reservoir catfish stockings (i.e., consider number of largemouth bass per unit area, not just biomass of largemouth bass per unit area).

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Table 1. Number and weight of blue catfish (60-95 mm total length, TL) and channel catfish (42-60 mm TL) stocked August 1989, and forage and predator fishes stocked in catfish survival ponds (Spring 1988 - Spring 1989) and removed (October 1989) when ponds were drained to examine catfish survival. All weights are rounded to the nearest whole value; YOY = young-of-the-year; LMB = largemouth bass.

	Pond 6		Pond 8		Pond 9	
Species	N	kg	N	kg	N	kg
	Preparatory and interim stocking (1988-1989)[a]					
Goldfish-adults	0	0	0	0	0	0
Goldfish-YOY	12,712	227	12,712	227	12,712	227
Gizzard shad	12	2	12	2	12	2
Golden shiner	100	1	100	1	100	1
Fathead minnow	600	2	600	2	600	2
Green sunfish	15	1	15	1	15	1
LMB-adults	164	80	82	73	144	99
Channel catfish-YOY	238	<1	188	<1	248	<1
Blue catfish-YOY	238	<1	188	<1	248	<1
	Removed-Oct 1989					
Goldfish-adults	204	83	110	47	177	83
Goldfish-YOY	0	0	52,976	19	0	0
Gizzard shad-adults	161	60	136	42	150	52
Gizzard shad-YOY	134	3	1,560	35	2,986	67
Golden shiner	636	5	99	2	33	<1
Inland silverside	0	0	0	0	6,258	2[b]
Green sunfish-adults	15	<1	28	2	20	1
Green sunfish-YOY	12,386	51	10,200	42	2,888	12
LMB-adults	146	92	80	85	121	75
LMB-YOY	728	3	660	6	1,548	10
Blue catfish-YOY	5	<1	17	<1	4	<1
Channel catfish-YOY	8	<1	30	<1	7	<1

[a] Study ponds had previously been stocked with adult goldfish to allow natural forage production; the number of adults and YOY goldfish present at the start of this study was uncertain, but should have been similar in each pond.

[b] Although silversides were not specifically stocked in test ponds during the study, they were present in other adjacent research station ponds and apparently an inadvertent transfer of silversides or their eggs occurred.

Table 2. Number, weight and density of blue (60-95 mm TL) and channel catfishes (42-60 mm TL) recovered 9 weeks after stocking in ponds containing established populations of largemouth bass and forage fishes at Heart of the Hills Research Station, Ingram, Texas, 1989.

Species	Pond 6	Pond 8	Pond 9
Number stocked:			
Blue catfish	238	188	248
Channel catfish	238	188	248
Number recovered:			
Blue catfish	5	17	4
Channel catfish	8	30	7
Number/ha recovered:			
Blue catfish	5.19	22.34	3.98
Channel catfish	8.30	39.44	6.97
Largemouth bass	151.61	105.12	121.00
Kg/ha recovered:			
Blue catfish	0.05	0.15	0.04
Channel catfish	0.07	0.25	0.06
Largemouth bass	95.80	111.43	74.66
Percent Survival:			
Blue catfish	2.1	9.0	1.6
Channel catfish	3.4	16.0	2.8