Effects of Direct Stocking and Hatchery Feeding on Growth and Survival of Channel Catfish Swim-Up Fry

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ABSTRACT. Channel catfish, *Ictalurus punctatus*, swim-up fry were either stocked directly into prepared nursery ponds or fed a prepared diet in hatchery tanks for seven days prior to stocking in ponds to evaluate the effects of hatchery feeding on growth and survival in ponds. Two experiments were conducted during two growing seasons (1991 and 1992). Nursery ponds in both treatments were prepared and fertilized according to standard recommended procedures. Survival was significantly higher ($P < 0.05$) in fish not fed prior to stocking in both experiments. At harvest, there was no significant difference ($P > 0.05$) in average weight between treatments in either experiment. In experiment 1, total yield was significantly higher ($P < 0.05$) in fish that did not receive hatchery feeding. There was no significant difference ($P > 0.05$) in feed conversion ratio (FCR) in experiment 1. During experiment 2, FCR was significantly lower ($P < 0.05$) in fish not fed prior to stocking. Results indicate that stocking of channel catfish swim-up fry into properly prepared nursery ponds is a suitable method for fingerling production.

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INTRODUCTION

Feeding of channel catfish fry in hatchery troughs for two to ten days before transfer into nursery ponds is often recommended (Tucker and Robinson 1990). However, it has been reported that fry may be released directly into nursery ponds with suitable results (Busch 1985). Snow (1962) reported that pond survival of channel catfish yolk-sac fry (not yet ready to feed) stocked directly into ponds was only 50% that of fish fed for 15 to 25 days in tanks prior to pond stocking.

Stocking of fry into prepared nursery ponds at the onset of feeding behavior has proven to be an efficient method of fingerling production for several species, including hybrid striped bass, *Morone saxatilis* (Geiger et al. 1985); paddlefish, *Polyodon spathula* (Mims et al. 1991); walleye, *Stizostedion vitreum* (Nickum 1986); and yellow perch, *Perca flavescens* (Heidinger and Kayes 1986). If this method could be efficiently utilized for catfish fry, facility requirements, labor, and risks associated with raising fry in the hatchery may be reduced. The purpose of this study was to evaluate growth and survival of channel catfish swim-up fry (the stage when exogenous feeding behavior begins) stocked directly into ponds with fry fed for seven days in hatchery troughs prior to stocking in ponds.

MATERIALS AND METHODS

Experiment 1

Egg masses were collected from broodfish at the Kentucky State University Aquaculture Research Center. Egg masses were treated for 1 h with formalin, then placed in a flowing water hatchery trough (27°C). When "swim-up" activity was observed, fry in the unfed treatment were stocked the following morning into three 0.04-ha earthen ponds previously prepared as described by Jensen et al. (1983). Fry receiving a prepared diet (fed treatment) were transferred to hapas floating in 3,000-L fiberglass tanks with an overhead spray of water. Fry were fed a 50% crude protein commercial trout starter (Ziegler Brothers, Gardners, Pennsylvania[1]) every two hours for seven days using automatic feeders. Two to three times per day fish were also fed to apparent satiation by hand. Fry were individually counted and stocked at a rate of 49,000/ha.

After stocking into ponds, fish were fed according to a standard feed

1. Use of a trade or company name does not imply endorsement.

chart (Jensen et al. 1983). Estimated body weights were calculated weekly, based on an assumed 1.5 feed conversion ratio (Tidwell et al. 1991). Fish were sampled monthly, and biomass estimates were adjusted accordingly. Feed rates, feed type, and particle size were adjusted according to fish size (Dupree 1984).

Ponds were monitored twice daily (0900 and 1300) for dissolved oxygen concentration and temperature, with a YSI Model 57 oxygen meter (Yellow Springs Instruments, Yellow Springs, Ohio). Ponds were aerated by electrical vertical-pump aerators if graphic plots indicated nighttime oxygen levels would reach ≤3mg/L. Ammonia and nitrite were measured weekly with a model DREL/5 spectrophotometer (Hach Co., Loveland, Colorado). The pH was measured weekly (1300) with a pH pen (Fisher Scientific, Cincinnati, Ohio). Overall means for water quality variables within each experiment are presented in Table 1.

Fish were not fed 24 hours prior to harvest. Total number of fish in each pond was recorded at harvest. Fifty fish were randomly sampled from each pond and were individually weighed to the nearest gram and measured (total length) to the nearest 0.5 cm. In experiment 1, ten fish were randomly sampled from each pond for analysis of body composition. Whole fish were homogenized separately in a blender and analyzed for percentage moisture, protein, and fat. Protein was analyzed using the macro-Kjeldahl method; fat was analyzed by ether extraction; moisture was determined by drying a 6-g sample in a convection oven until a constant weight was reached (Association of Official Analytic Chemists 1990).

Experiment 2

All hatching and stocking procedures were as given for experiment 1, except the stocking rate was increased to 74,000/ha and fish were not analyzed for body composition at termination.

Data in both experiments were analyzed by Student's t-test, using SAS procedures (SAS 1990). Percentage data were transformed to arc sin values prior to analyses (Zar 1984).

RESULTS AND DISCUSSION

Survival was significantly greater ($P < 0.05$) in channel catfish stocked directly into ponds as swim-up fry than in fish fed in the hatchery for seven days prior to stocking in both experiments (Table 2). Mean survival of fish in the unfed treatment was 162% greater than survival of fish in the

TABLE 1. Temperature (afternoon), dissolved oxygen (afternoon), total ammonia-nitrogen (TAN), nitrite-nitrogen, and pH in ponds stocked with channel catfish stocked directly as swim-up fry (unfed) or fed in the hatchery for seven days prior to stocking (fed). Means ± SE within an experiment were not significantly different ($P > 0.05$).

Experiment	Treatment	Temperature (°C)	Dissolved oxygen (mg/L)	TAN (mg/L)	Nitrite (mg/L)	pH
1	Fed	25.9 ± 0.1	7.2 ± 0.5	0.53 ± 0.11	0.08 ± 0.01	8.7 ± 0.1
	Unfed	25.4 ± 0.2	7.4 ± 0.33	1.00 ± 0.9	0.04 ± 0.02	8.7 ± 0.5
2	Fed	24.2 ± 0.2	6.3 ± 0.2	0.77 ± 0.43	0.05 ± 0.00	8.8 ± 0.2
	Unfed	24.2 ± 0.1	6.7 ± 0.1	0.98 ± 0.46	0.05 ± 0.02	8.8 ± 0.0

fed treatment during experiment 1 and 35% greater during experiment 2. Survivals in the unfed treatments of experiments 1 and 2 (82 and 86%, respectively) were similar to those reported by Snow (1962; 68-78%) when fry were stocked directly into nursery ponds and not fed in the hatchery. Snow (1962) analyzed and reported hatchery and pond mortalities separately. However, if his data for hatchery mortality are considered additive with pond mortality, survival of fry started on feed in troughs (74.6%) and those stocked directly into ponds (74.7%) is almost exactly the same, indicating no overall advantage (from hatch to harvest) for hatchery fed fish. Also, Snow (1962) stocked yolk-sac fry, which are not yet able to begin exogenous feeding, possibly increasing their period of susceptibility to predation, compared to swim-up fry.

Average individual weight was not significantly different ($P > 0.05$) between fry fed for seven days in the hatchery and those stocked directly into nursery ponds in both experiments (Table 2). Mean pond yield was significantly higher ($P < 0.05$) in fish stocked directly into nursery ponds at swim-up during experiment 1 than in fry fed in the hatchery prior to stocking. Yield was 22% higher in unfed fish during experiment 2, though this difference was not statistically significant ($P > 0.05$). Differences in pond yields largely reflect different survival rates as average individual weights of fish in the two treatments were very similar within years.

During experiment 1 there was no significant difference in feed conversion ratios (FCR). Feed conversion ratios in some fish fed in the hatchery prior to stocking were very high, possibly due to early undetected mortalities. This may have resulted in calculated feed rates (which uses assumed survival) to be excessive. During experiment 2, FCR was significantly lower ($P < 0.05$) in fish not fed prior to stocking, indicating more efficient feed utilization and possibly reflecting higher survivals. There was no significant difference ($P > 0.05$) in body composition variables between fish in the two treatments during experiment 1 (Table 3).

It appears that hatchery feeding prior to pond stocking may not be of significant benefit to channel catfish growth and survival under the conditions encountered in the two experiments reported here. If natural food items of the proper size are present in abundance and predatory insects are controlled, fry may be stocked directly into nursery ponds without a period of hatchery feeding. Mims et al. (1989) showed that transportation of eggs from the Deep South could functionally extend the growing season for catfish fry in temperate climates by two to four weeks. Tidwell et al. (1991) demonstrated that transportation of fry was a more economical method to produce large fingerlings than transportation of eggs. Results of the current study indicate that under certain conditions, stocking fry di-

TABLE 2. Survival, average individual weight, pond yield, and feed conversion ratio (FCR) of channel catfish stocked directly into ponds as swim-up fry or fed in the hatchery for seven days prior to stocking. Means ± SE within a column (within experiments) not followed by different letters are not significantly different ($P > 0.05$).

Experiment	Treatment	Survival (%)	Average individual weight (g)	Pond yield (kg/ha)	FCR
1	Fed	31.1 ± 15.7b	78.8 ± 12.5a	1164 ± 421b	7.5 ± 6.8a
	Unfed	81.5 ± 4.0a	79.0 ± 2.5a	3178 ± 253a	1.5 ± 0.1a
2	Fed	63.5 ± 2.1b	92.1 ± 8.1a	4189 ± 262a	1.7 ± 0.1a
	Unfed	86.0 ± 7.1a	96.5 ± 25.1a	5090 ± 594a	1.3 ± 0.1b

TABLE 3. Whole body composition (moisture, lipid, and protein; wet-weight basis) at harvest of channel catfish fingerlings which had been stocked directly into ponds at swim-up (unfed treatment) or fed in the hatchery for seven days prior to stocking (fed treatment) during experiment 1. Means ± SE of two replicate ponds for treatment. Individual replicate pond values represent a composite sample of five fish. Differences in treatment means were not statistically different ($P > 0.05$).

Treatment	Moisture (%)	Lipid (%)	Protein (%)
Fed	71.2 ± 0.0	8.9 ± 0.7	15.6 ± 0.7
Unfed	71.6 ± 0.4	8.2 ± 0.7	14.4 ± 0.5

rectly into prepared nursery pond is a suitable method for production of catfish fingerlings and may reduce the costs, facilities requirements, and risks inherent in the hatchery feeding period.

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